GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

This 480-v loop pays • 84

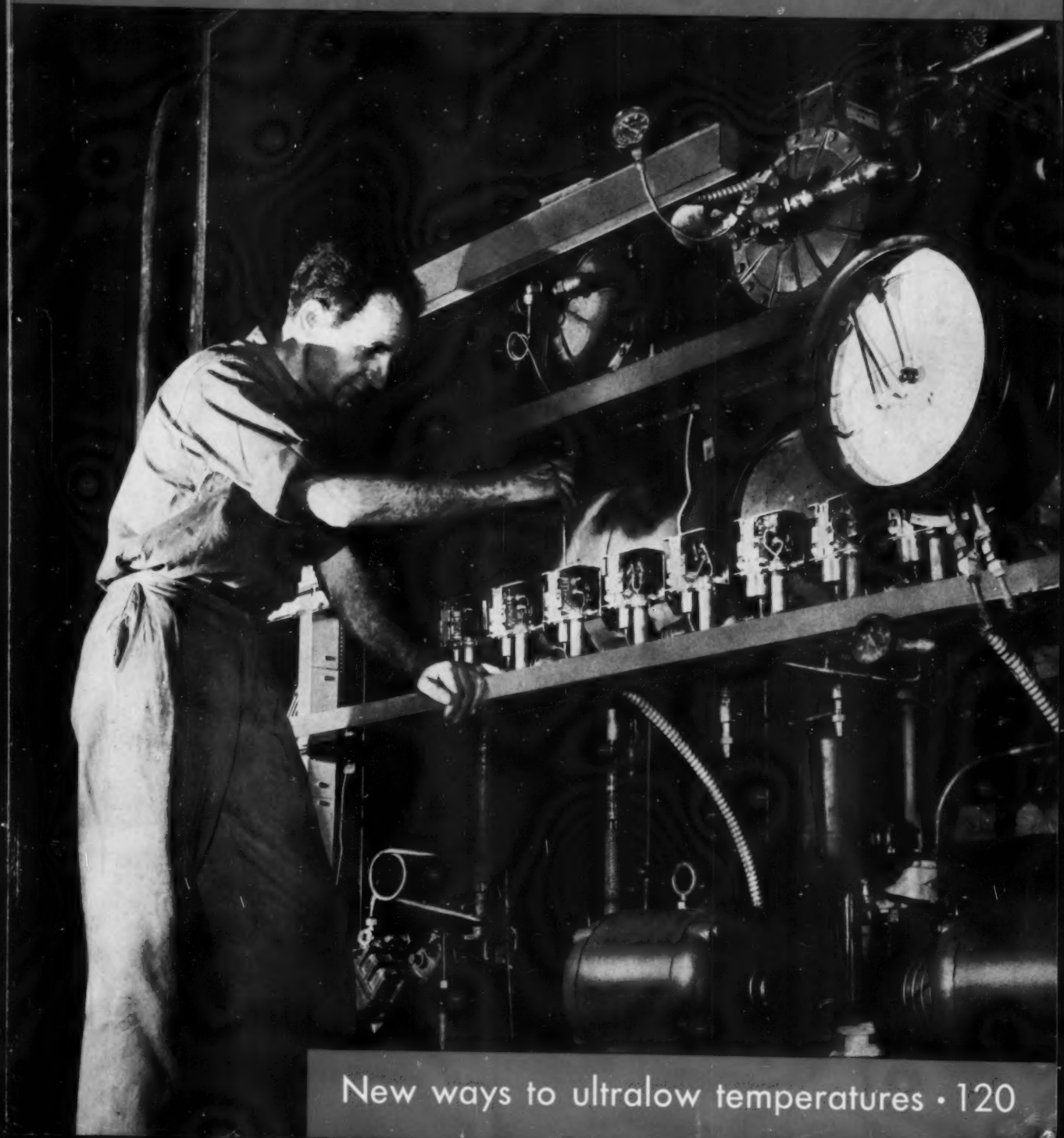
How pulsating combustion works • 88

Check heating now • 122

Power

AUGUST
1954 • 50¢

A McGRAW-HILL PUBLICATION



New ways to ultralow temperatures • 120

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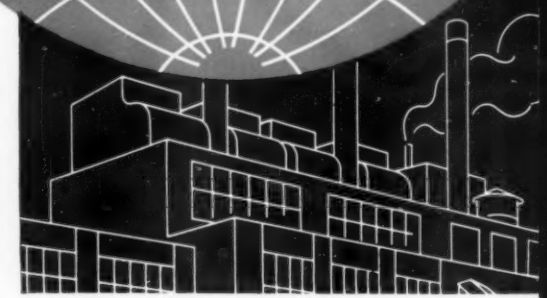

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Offices and Representatives in Principal Cities

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materials handling systems

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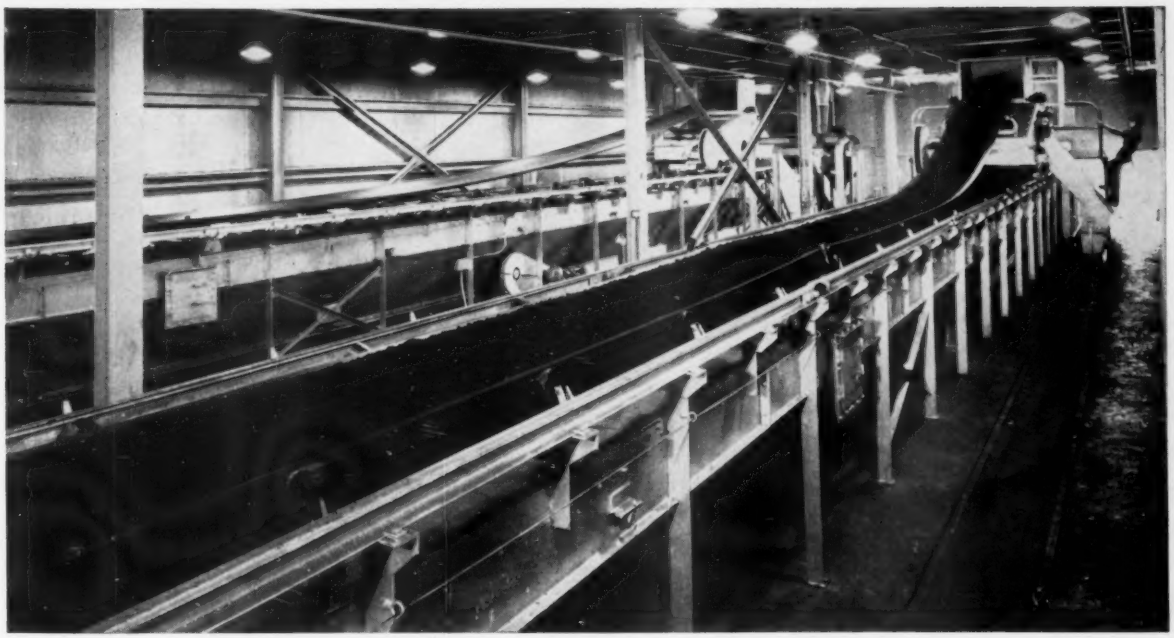

Engineered for long-life in coal handling, these twin Link-Belt 36-in. wide belt conveyors employ Series 100 troughing idlers, welded steel pulleys, and self-propelled trippers with bunker seals.

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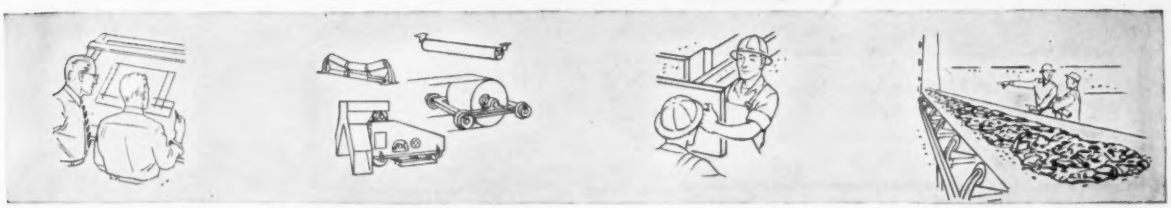

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Link-Belt follows through on every detail of the job, including electrical controls and even wiring and foundations. What's more, Link-Belt will furnish experienced erection superintendents, staffs and skilled crews.

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When you rely on Link-Belt as a single source for your complete system, Link-Belt accepts responsibility for placing it in full operating readiness. We will also supervise modernization of existing systems.

Next time you're in the market for one belt conveyor or a complete system, call a conveying expert in the Link-Belt office near you. It's his job to help you get the best in belt conveying at the lowest possible overall cost.

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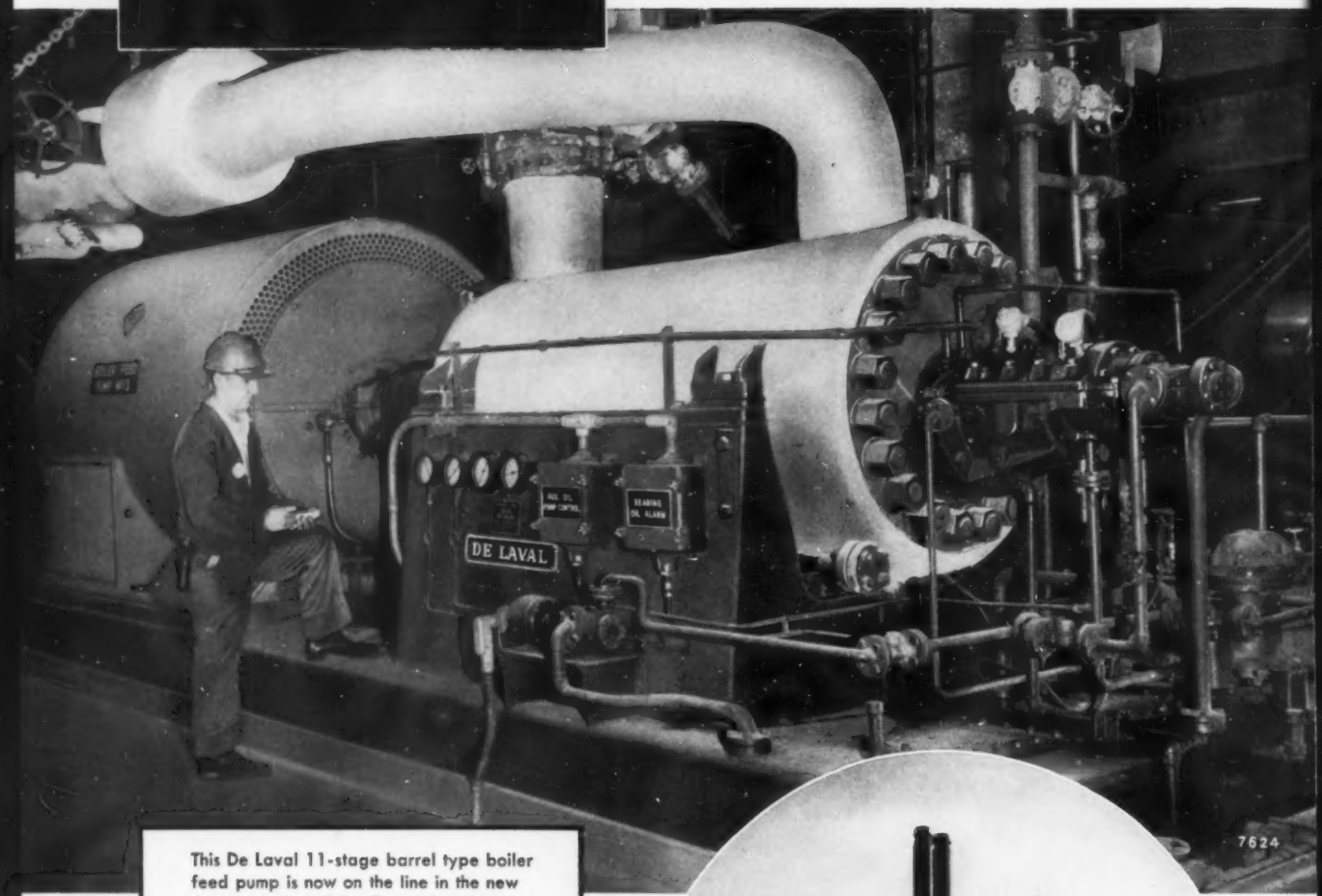
13,390-D

DE LAVAL
BARREL TYPE BOILER FEED PUMP

in new Con Edison *Astoria power station*



This De Laval 11-stage barrel type boiler feed pump is now on the line in the new Astoria station of the Consolidated Edison Co. of New York.

The De Laval 8/6 pump operates at 129 psig suction pressure and delivers 1,570 gpm of 344 F water against 2,229 discharge pressure. Direct-connected at the end of the boiler feed pump shaft is a De Laval IMO pump for lubrication of the main pump and motor bearings. Also furnished is a motor-driven De Laval IMO auxiliary oil pump with pressure controlled switches. De Laval barrel type boiler feed pumps meet all the requirements of high pressure, high temperature boiler feed service. The distinctive De Laval design assures years of reliable operation with minimum maintenance.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

Power

AUGUST 1954 • VOLUME 98 NUMBER 8

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AUGUST 1954 POWER Vol 98—No. 8

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ULTRALOW TEMPERATURES keep finding new uses in industry. For example, metal-treating techniques such as stress equalization, hardening, shrink-fitting and quick aging are being done now at controlled temperatures down to –120 F. Soaking metals at these subzero levels can improve stability, impact strength and toughness, or give increased hardness, longer life. And in low-temperature test cells, researchers study effects of high altitudes or arctic conditions on aircraft parts, instruments, lubricants.

Cover shows a –150 F unit on final test at Tenney Engineering, Inc, Union, N. J. This 2-stage Freon-13 system (lower level) cascades to a single-stage Freon-22 system (upper level). For up-to-date know-how on such equipment, see p 120.

Next month . . .

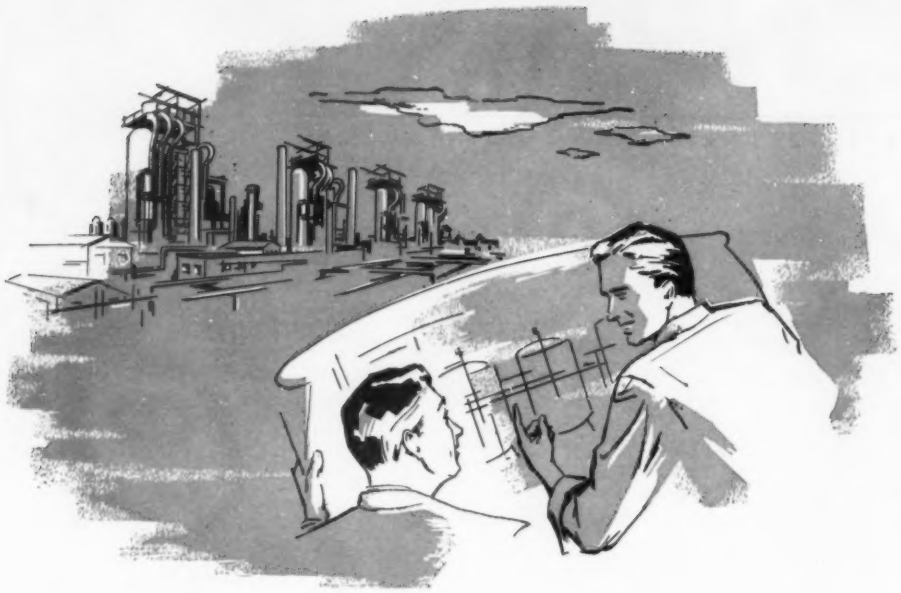
■ Ford Motor Co's Rouge power plant —one of world's biggest industrials— again sets the pace, this time with a complete revamping of steam-generating facilities. First of three upcoming articles analyzes the new boilers.

■ It's a simple matter to expand an existing electrical system by buying all new switchgear with the proper interrupting capacity. But where a plant has fairly new metalclad units, perfectly good within their rated limits, what's the best way to meet increased available short-circuit currents? Next month look for seven good answers.

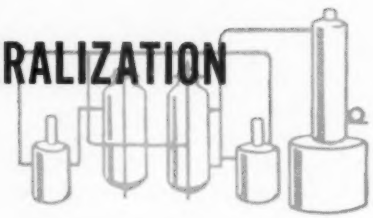
■ Ever have to time a diesel engine, starting from scratch (and we mean that literally) by marking the flywheel, setting the valves, timing the fuel pump and finally tuning the engine from indicator cards? Whether you have or haven't, the eight pages of September's *Operators' Notebook* will show you how it should be done, with about 40 photos taking you through each step in order.

. . . and future months

■ Another high spot of the Mid-September *Modern Plant Handbook* issue will be a roundup of successful modernization ideas, and announcement of plants receiving citations in POWER's Modernization Awards program.



HIGHER WATER PURITY BY DEMINERALIZATION



...A Cochrane Achievement

Long experience with *all* phases of water conditioning problems places Cochrane in the position of leader in the design and application of equipment to meet the exacting requirements of demineralization.

Cochrane Demineralizers now operating on boiler feed and process waters are continuously producing effluents with total dissolved solids and silica residuals approaching zero, within the limits of accuracy of available testing methods. These include 2-bed, 3-bed and 4-bed systems—compact mixed bed units—manually controlled or automatically operated.

Cochrane engineers and manufactures every type of ion exchange precipitation type water conditioning equipment—which assures you of unbiased recommendations for equipment best suited to your requirements. Its complete service provides single responsibility for engineering, fabrication and continued satisfactory operation.

For information on Cochrane Demineralizers, write for Publication No. 5800 and reprints on demineralization.

Other Cochrane Processes

HOT PROCESS SOFTENER

Highly efficient precipitation at high temperatures reduces hardness, silica, alkalinity and total dissolved solids. Publication No. 3000.

HOT ZEOLITE SOFTENER

Supplementing the Hot Process Softener, high temperature ion exchange resins completely remove residual hardness with substantial savings in soda ash and phosphate. Publication No. 4801.

SOLIDS CONTACT REACTOR

Slurry blanket principle efficiently removes solids, turbidity, color, taste, silica, fluorides; reduces alkalinity and hardness from water for boiler feed industrial process and municipal purposes. Publication No. 5001-A.

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Power

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...with Power readers...

TIGERS AND POWER . . .

Proud moment for Hrand Levonian is recorded in photo above: the v-p in charge of construction for Kuljian Corp kneels beside a Royal Bengal tiger (10 ft 6 in. long and 628 lb). Just returned from a 3-year stay in India supervising the building and operation of the $35 million Bokaro Thermal Power Station in the Damodar Valley, Levonian likes to recall occasional weekend big-game hunting expeditions.

He also likes to recall the solid accomplishments in the Damodar Valley, where Bokaro Station plays a vital role in the

(*Continued on page* 220)

...lines and bylines

J W Blake

GAS-TURBINE OVERHAUL (p 75) is right up Joel Blake's alley. He has been doing everything possible with turbines since 1924, when he got his BEE at Univ of Arkansas and went with GE.

Testing turbines, and then supervising installation, operation and trouble-shooting of both land and marine jobs, made him an all-around turbine man. Work included some of our largest battleships and aircraft carriers.

In 1936, he wound up with Oklahoma Gas & Electric Co and a few years ago, Joel was appointed Superintendent of Generation, his present post. While assistant super, he worked out the engineering basis for application of the first gas turbine for private utility use (POWER, Sept 1948).

Joel is proud father of two daughters and three sons, one an ensign aboard a destroyer-escort. When not working or thinking about turbines, Blake tinkers with wood and metal in a home workshop.

R H Shannon

NUCLEAR SERIES started in July is co-authored by Henry Schwenk and Robert Shannon. We didn't have a good photo of Bob then, but now we can introduce him. With his BS in ME from Texas A&M, he signed up with General Electric.

Before long, Bob was doing field work on steam turbines in the Philly district, then went to River Works at Lynn, again on steam turbines.

From 1943 to 1946 came a hitch in the Navy as engineering officer. After the war he joined United Engineers and Constructors, Inc, as power engineer, doing steam studies and designing utility and industrial power plants. In 1950, Bob was assigned to the Knolls Atomic Power Laboratory and since 1952 has been on assignment to the Dow Chemical-Detroit Edison and Associates atomic power project, doing some mighty interesting work in the program of hitching atoms and kilowatts into working harness.

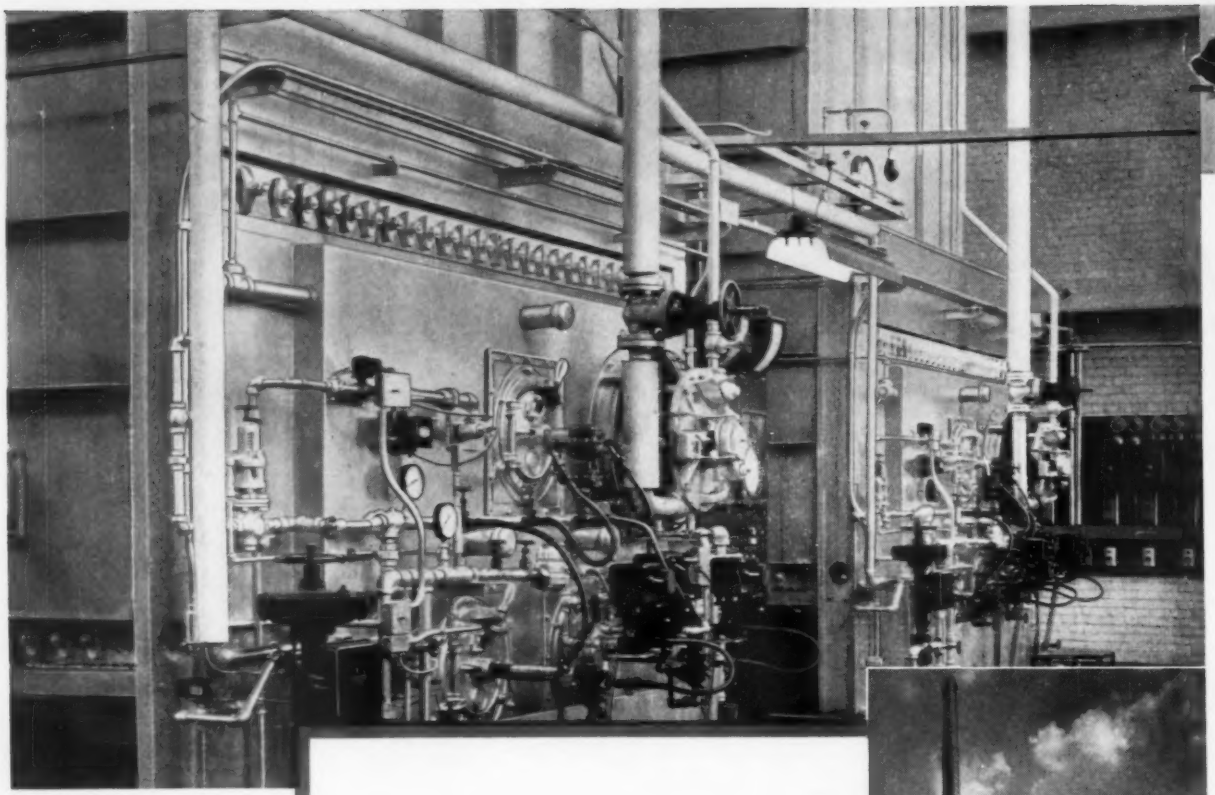
J P Kovacs

MIDNIGHT OIL is duck soup to Jules Kovacs, genial vice-president in charge of engineering for Purolator Products, Inc, Rahway, N. J. Attending school five nights a week for 12 years, Jules *earned* his ME from Newark College of Engineering, the tough way.

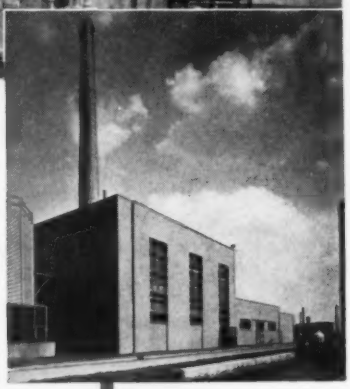
After working with various firms, he landed with Purolator in 1929 as design engineer—was promoted to his present post in 1949.

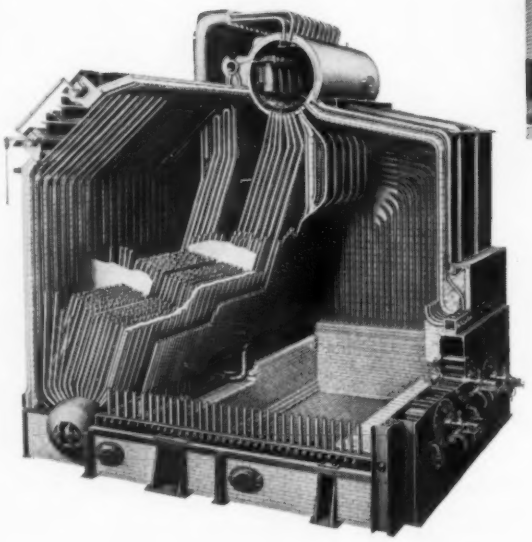
Author of the book "Aircraft Hydraulic System Filters and Elements," he holds many patents and has written numerous technical articles in his field. For his thoughts on selecting filters for your diesel's lube- and fuel-oil systems, turn to p 118.

Coming up the hard way has taught Kovacs the importance of helping youngsters with talent. His key engineers are men he selected from jobs in the plant (see *Argument Corner*, p 136). He helped them every way possible to develop into top engineers, which is, incidentally, one way to solve the engineer shortage. Jules still takes time to give informal advice to students, lectures at engineering schools.



This installation of B&W Integral-Furnace Boilers at the Chicago plant of Wesson Oil Co. is producing "cheap" steam through efficient operation and with minimum maintenance and labor.





Sectional view of typical oil-fired B&W Integral-Furnace Boiler similar to units in service at Wesson Oil plant. Suitable for oil, gas, and coal firing the Integral-Furnace Boiler family is available in steam capacities to 350,000 lb per hr. Cost saving features covered in bulletins available on request.

G-633

on the record . . .

2 B&W Integral-Furnace Boilers at Wesson Oil's New Chicago Plant provide

PERFORMANCE with ECONOMY

Despite unusually severe operating conditions, with frequent and wide load swings at odd times and without warning, two B&W Integral-Furnace Boilers at this plant are providing steam efficiently and economically, to the complete satisfaction of company engineers. And performance such as this is being duplicated in plant after plant across the country—both new and old—where operational savings over a relatively few years are proving sufficient to cancel the initial investments.

Southern Cotton Oil Company—processor of the popular Wesson Oil and hydrogenated shortening—needed a fully-reliable steam supply for its new Chicago plant, with "push-button" operation wherever practical. To meet these requirements, they chose long-life, automatically controlled B&W Integral-Furnace Boilers. Oil-fired at present, they can also burn gas and may be converted readily to coal firing if conditions warrant. Each unit has a steam capacity of 40,000 lb per hr at pressures to 250 psi. They supply steam for year 'round processing and carry the additional load for heating during winter months.

An efficient system of automatic controls makes operation of these B&W Integral-Furnace Boilers quite simple. This emphasis on automatic operation has "paid off" at the new plant, which is producing steam with minimum maintenance and operating labor. These advantages are, of course, reflected in the plant's low overall steam cost.

Layout of the boilers and plant was under the direct supervision of Mr. L. C. Haskell, vice president of Southern Cotton Oil, working with the company's consulting engineers, The Austin Company, who designed and constructed the building. B&W erected the boilers, then ran complete operational tests before turning them over to Southern Cotton Oil Company as satisfactory, operating units. We shall be glad to discuss details of any unit in the B&W "family" of Integral-Furnace Boilers in terms of your steam requirements. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd St., New York 17, N. Y.

Service-Proved

COST SAVING FEATURES

of B&W Integral-Furnace Boilers for Steam Requirements from 2900 to 350,000 Lb Per Hr.

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler-water concentration
- Quick response to wide and heavy load swings
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX

BOILER DIVISION

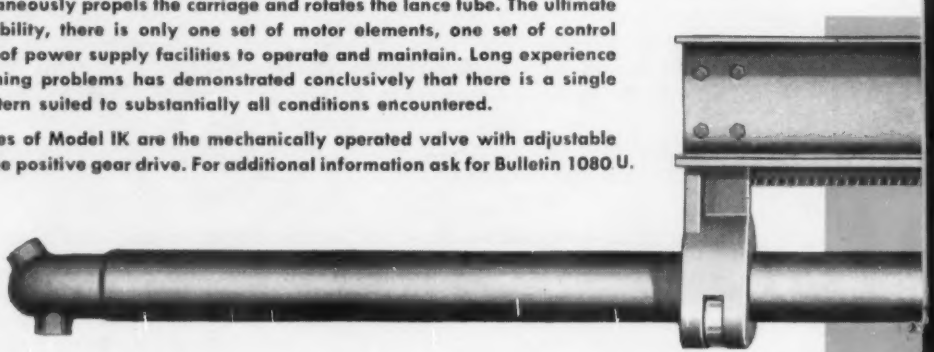
A Diamond Policy for Decades:

"Keep It Basic" • "Avoid Unnecessary Complications"

Diamond engineers have always felt that it isn't enough to design a mechanism that will do a particular job. It is also important to make that mechanism as simple and dependable as possible. It has been a Diamond policy for decades to *"keep it basic"*... to avoid unnecessary complications that make trouble for users.

Diamond Soot Blowers are simple, effective, dependable. Typical of this is the single motor drive on the Model IK Long Retracting Blower. One motor working through a simple system of rugged gears simultaneously propels the carriage and rotates the lance tube. The ultimate in simplicity and reliability, there is only one set of motor elements, one set of control elements, and one set of power supply facilities to operate and maintain. Long experience with all kinds of cleaning problems has demonstrated conclusively that there is a single universal cleaning pattern suited to substantially all conditions encountered.

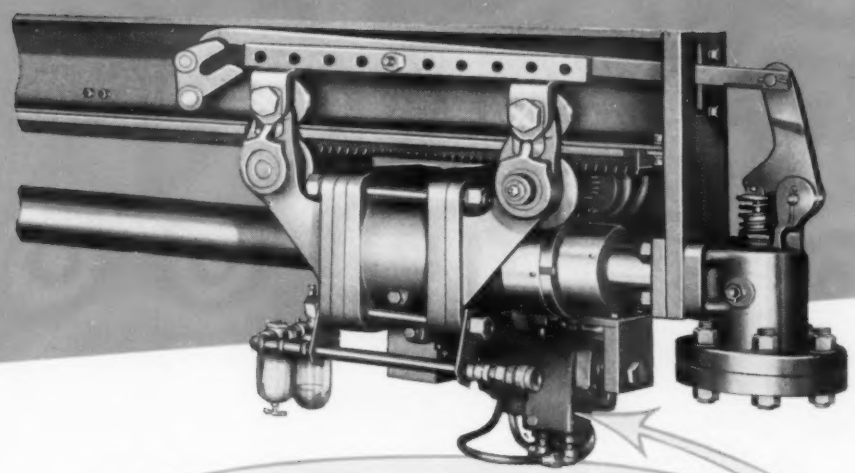
Other important features of Model IK are the mechanically operated valve with adjustable pressure control, and the positive gear drive. For additional information ask for Bulletin 1080 U.



The many advantages of Diamond Model IK Long Retracting Blowers are explained in Bulletin 1080 U, write for a copy.

6910

For Example... SINGLE MOTOR DRIVE on DIAMOND Model IK Long Retracting Blowers



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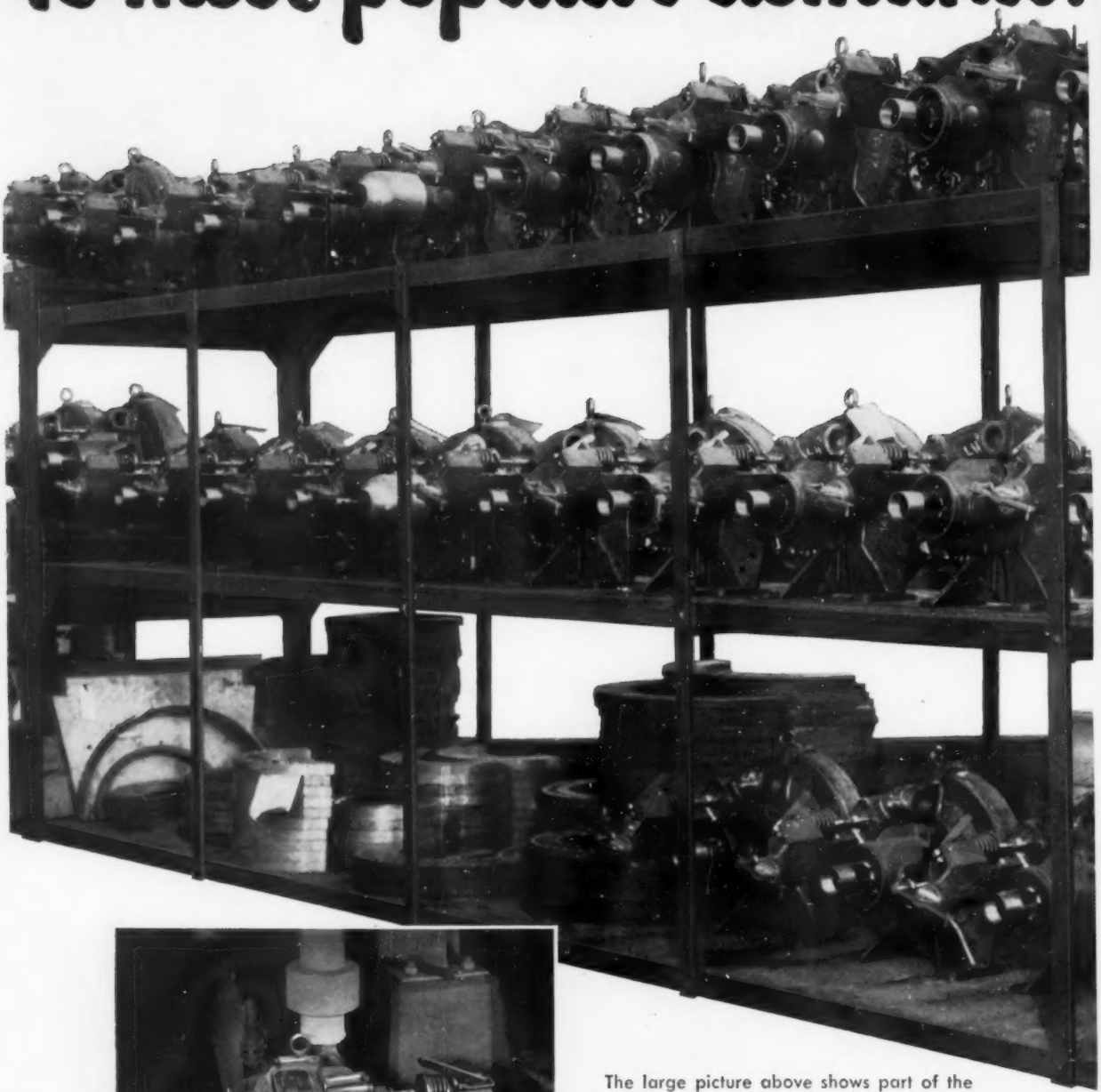
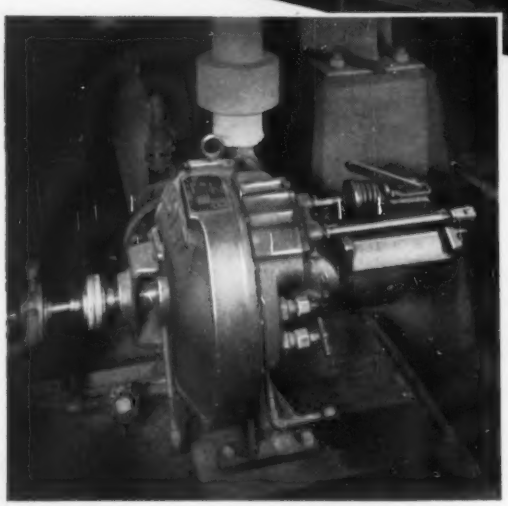
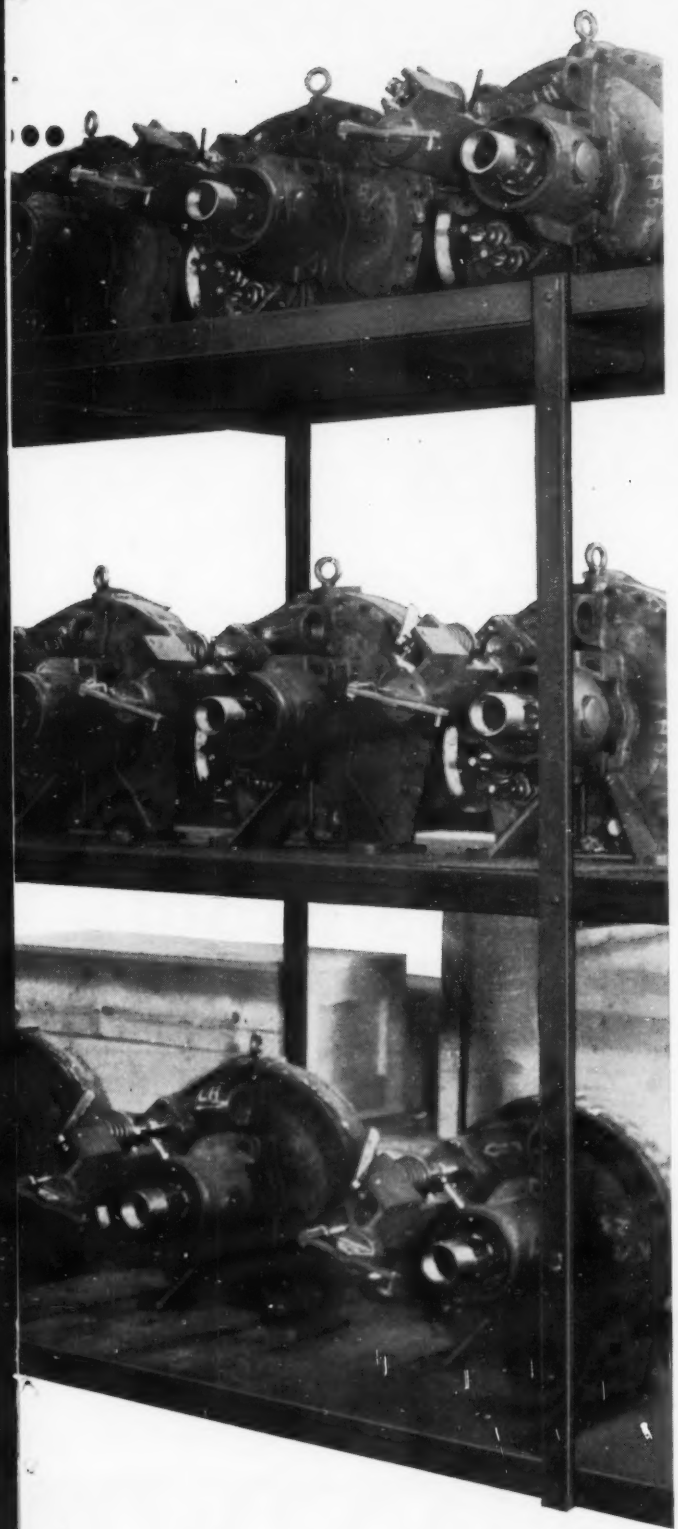




The large picture above shows part of the stock of JR turbines constantly kept on hand for quick shipment. At left, on the lower shelf, standard JR turbine parts, always available to quickly meet maintenance needs.

At left, an Elliott JR turbine coupled to a small pump. This picture shows the emergency trip mechanism and the two hand valves.

H4-4

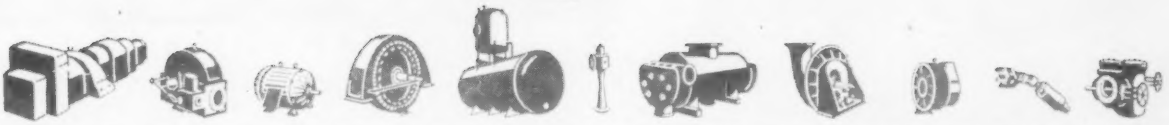


ELLIOTT JR MECHANICAL DRIVE TURBINES

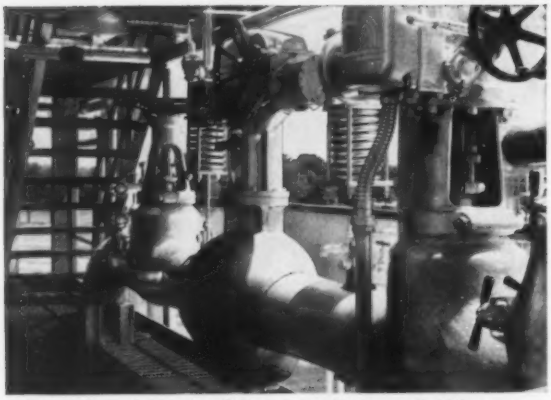
are in big demand wherever conditions call for a small turbine of minimum first cost. Without sacrifice of ruggedness or reliability, these turbines are engineered for production as well as for performance. This junior member of the Elliott turbine family has everything needed to operate up to high Elliott standards. Equipment includes direct-acting mechanical shaft constant-speed governor, built-in emergency over-speed trip operating an independent positive-closing emergency trip valve, hand speed changer, two hand valves, removable carbon packing rings, chromium plated shaft under the carbon rings, and grease-packed shaft and governor ball bearings.

Elliott JR turbines are production built, preassembled, stocked and ready for 24-hour shipment. Contact your local Elliott field engineer for full details, or write Elliott Company, Jeannette, Pa., for a copy of the JR Turbine Bulletin H-20A.

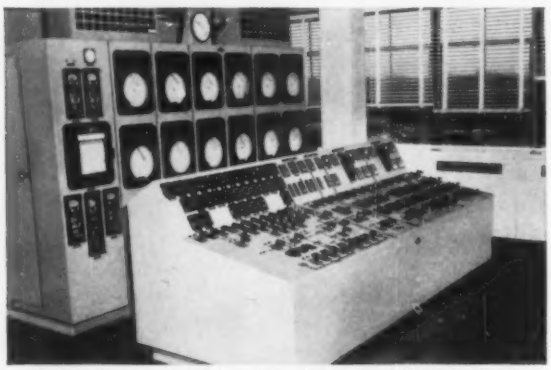
ELLIOTT Company



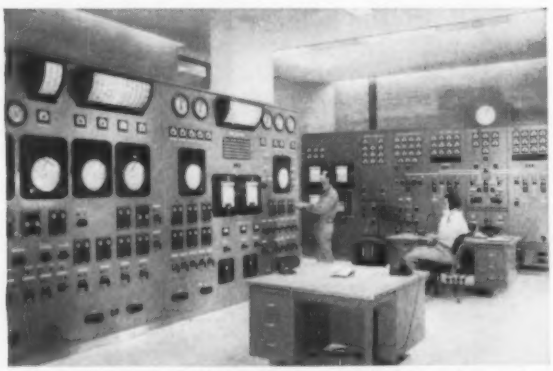
TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS



Bailey Three-element Feed Water Control Valve is feed line to a 450,000 lb per hour boiler.

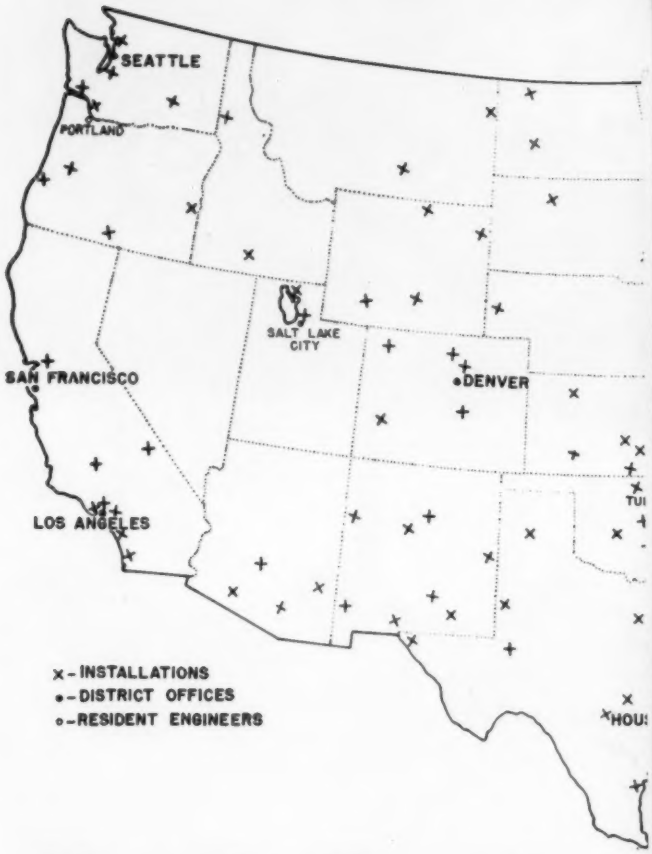


Operator's station for Bailey Three-element Feed Water Control is located in this compact control room.



(Above) Bailey Boiler Control Panel for 750,000 lb per hour unit including Three-element Feed Water Control.

(Below) Bailey Control Valve in feed water line to above unit.



Here's Proof—

Bailey Is Your Best Buy in

More than 1000 large boiler units are equipped with Bailey Three-element* Feed Water Control for close regulation of drum level, added safety, and added efficiency.

That Bailey is better than a 2 to 1 favorite against the combined total of all other makes used in this service is borne out by checking the 173 steam-electric stations listed by Electrical World in its design issues of May 8, 1950 and April 7, 1952. No wonder we can say Bailey is your best buy.

Such an endorsement by users of power equipment doesn't just happen. It's the result of carefully weighing all factors: design superiority, accuracy of operation, dependability in service, and the experience of the

BAILEY METER

1036 IVANHOE ROAD

Complete Controls for

1000 times!

Feed Water Control

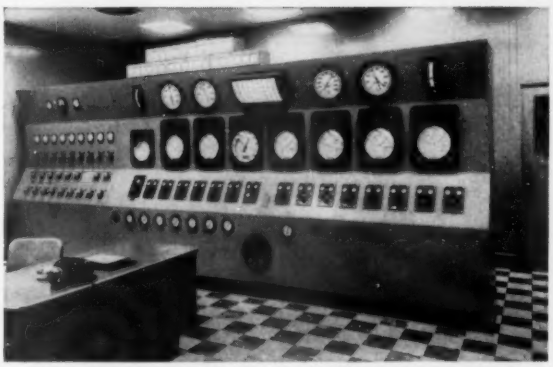
manufacturer in building and servicing this type of equipment.

That's why you should check with users before you buy. And you'll find a Bailey user near you. We couldn't spot over 1000 installations on one small map—but from those we were able to show, you can get some idea of Bailey's universal popularity—and how easy it is to get service with a minimum of travel time and expense. Call your nearest Bailey Office—they will be glad to arrange an inspection tour for you. And if you want catalog information, including a list of users, write for Bulletin 105-C Bailey Meter Company. A-123-2

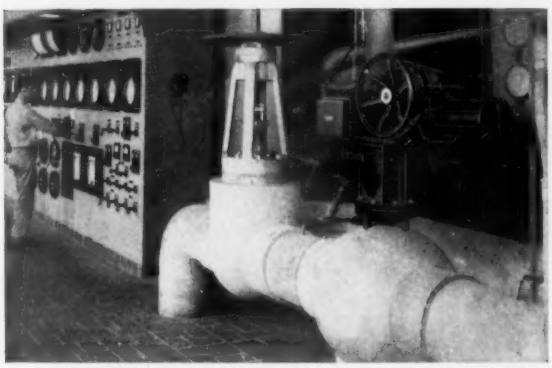
*The three elements are—1. Steam Flow from Boiler
2. Water Flow to Boiler
3. Water Level in Drum

COMPANY
CLEVELAND 10, OHIO
Steam Plants

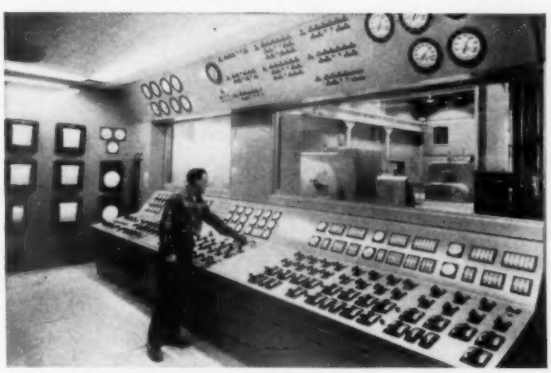
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS



This control room, which serves a 500,000 lb per hour boiler, includes an operator's station for Bailey Three-element Feed Water Control.



This 575,000 lb per hour Bailey Feed Valve is automatically operated by Three-element Feed Water Control.

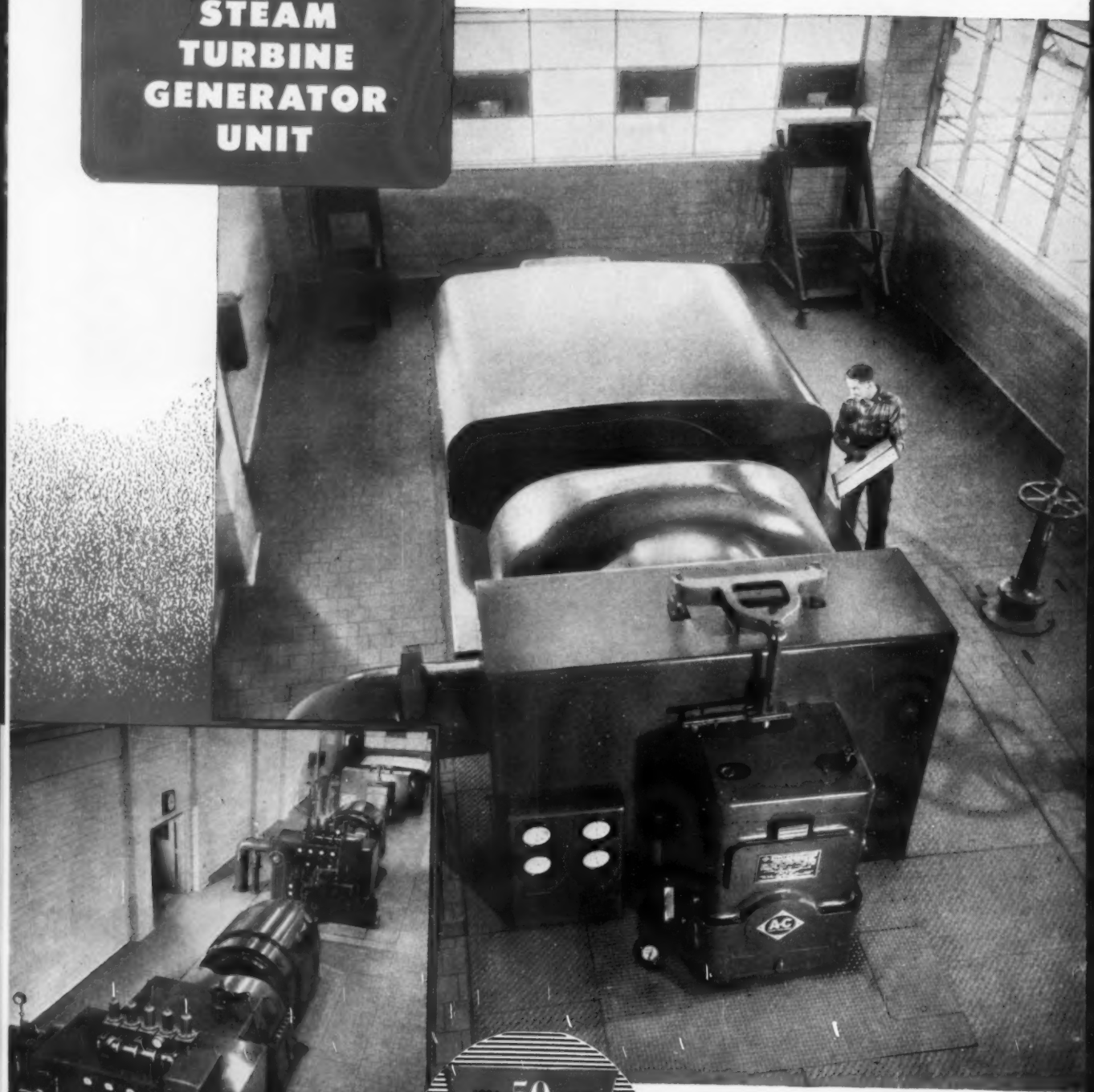


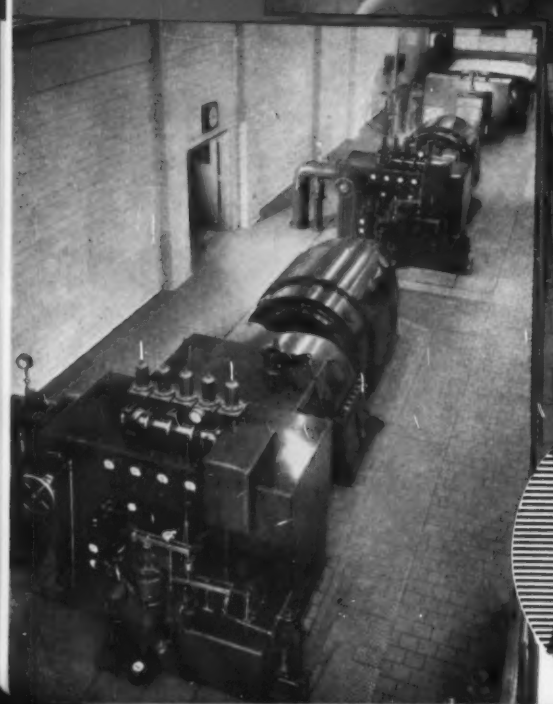
(Above) Operators' stations for Bailey Three-element Feed Water Control are concentrated in this centralized control room for three 250,000 lb per hour boilers.

(Below) Three-element Feed Water Control is part of the complete Bailey Control System operating two 500,000 lb per hour boilers from this control room.

Steam

WA-Series
STEAM TURBINE GENERATOR UNIT



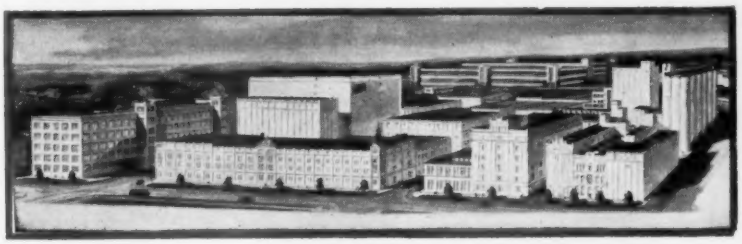


1904 50 YEARS 1954
TURBINE

ALLIS-

Works Twice

FOR WORLD-FAMOUS BREWER



Jos. Schlitz Brewing Company Uses Steam for Both Processing and Power Generation

Great quantities of steam are required for production of the "beer that made Milwaukee famous" at a rate exceeding six million barrels of beer a year. With so much steam needed for process, the electric power needed for plant operation is generated as a by-product.

At the Schlitz home plant in Milwaukee, two Allis-Chalmers 2500-kw, automatic extraction condensing turbine-generator units have been supplying process steam and electric power for the past five years. Recently, when more generating capacity was needed to match rapid plant expansion, Schlitz again turned to Allis-Chalmers.

Now operating 24 hours a day, 7 days a week, the new 5000-kw turbine-generator shown here was installed in the space originally planned for a third 2500-kw unit. It consists of a condensing, automatic extraction, impulse turbine and a housing type, air-cooled generator and exciter all carefully engineered and manufactured to operate as an integrated unit.

Built for condensing or non-condensing service in NEMA standard ratings 2000 kw and larger, the modern WA-Series unit is designed to meet modern power plant requirements. Bulletin 03B7654 gives complete details. For your copy, just call your nearby A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4269

WA-Series Features

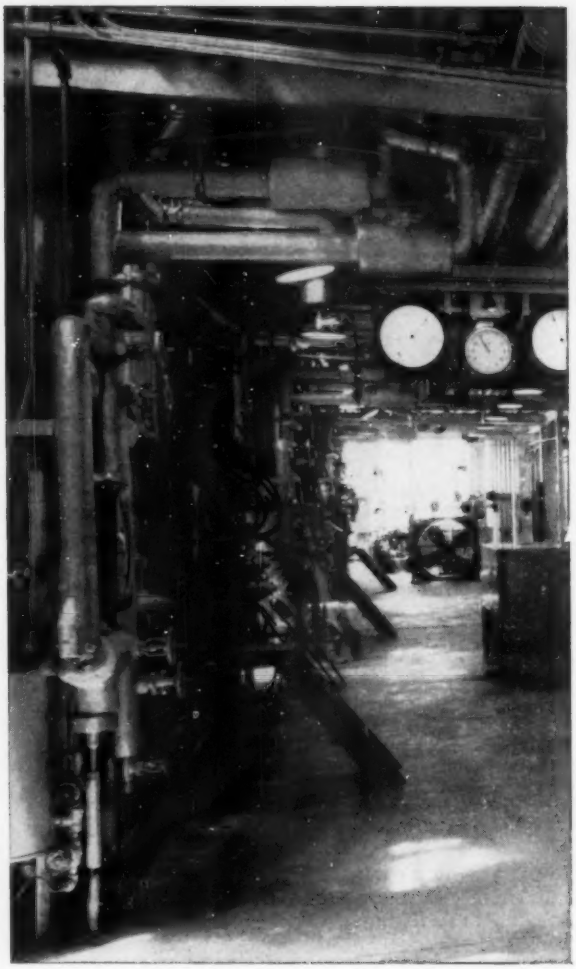
For easy installation and maintenance, every detail of the unit is designed for maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit that simplifies foundation requirements. Shipment of the turbine and the generator with their rotors in place further minimizes installation time.

Maximum reliability is assured by labyrinth spring-backed steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

CHALMERS

A-C ALLIS-CHALMERS

Controlling Costs Automatically



Republic Automatic Combustion Controls Offer All Types of Boiler Plants Three Ways to Save

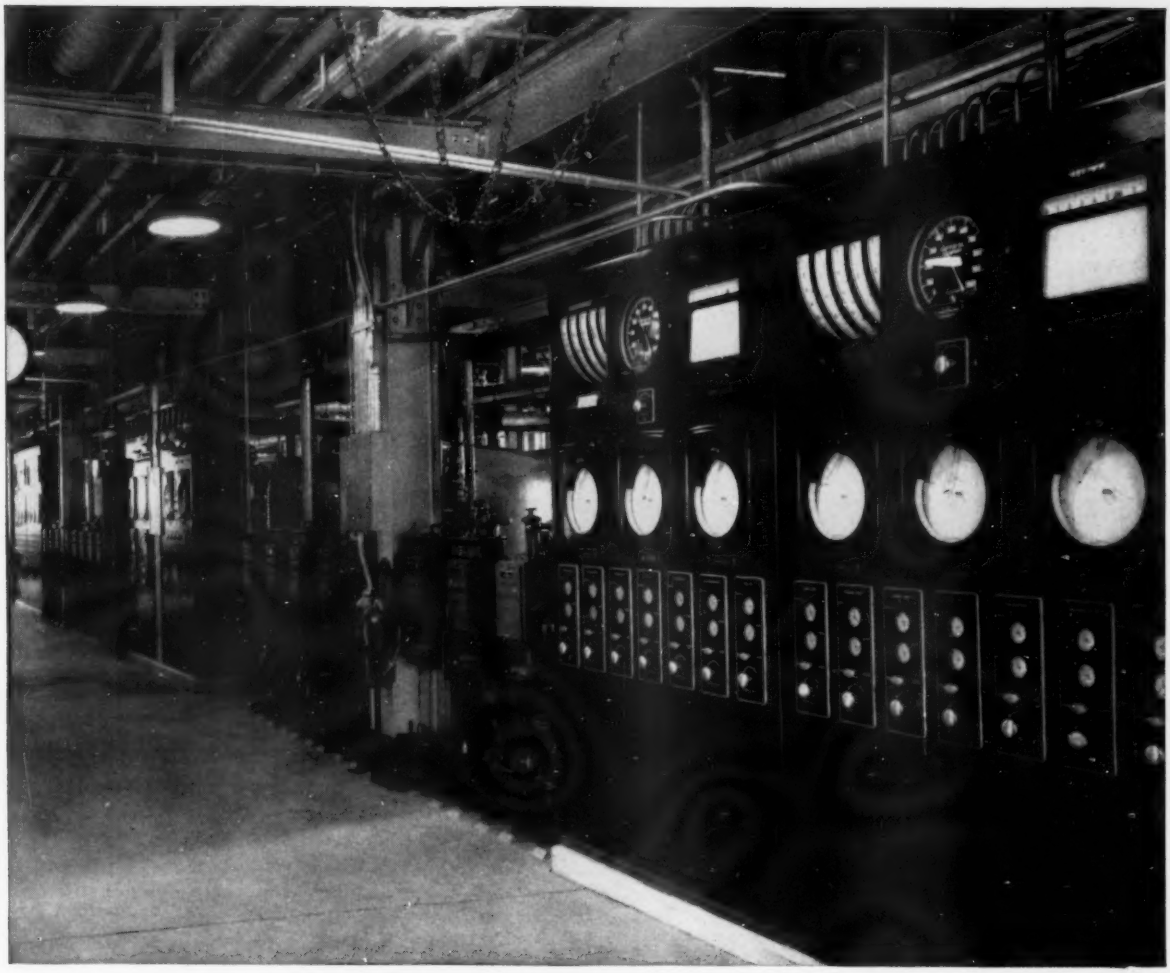
AUTOMATIC combustion controls are looked upon primarily as fuel savers. That's their most important advantage, but their effect on maintenance and equipment costs should not be overlooked, either.

For example, Republic Automatic Combustion Controls hold operating conditions uniform to prevent chain-of-event troubles and high maintenance costs that result from incorrect boiler operation. Republic controls, themselves, are ruggedly built to give years of dependable service.

Also consider the cost of stand-by equipment that must be purchased because boilers can't be continuously operated manually to produce the maximum steam output they are capable of generating. Human efficiency just isn't that good. Boilers operated by Republic Automatic Combustion Controls, however, perform at maximum efficiency, 24 hours a day, 7 days a week . . . at all loads. Expensive excess boiler capacity is not necessary to meet "peak" loads.

Republic Automatic Combustion Controls are used in all sizes and types of boilers, in central stations and in small industrial steam plants. Whatever the size or type of your boiler, the type of fuel burned or the load conditions, we can help you control costs by automatically controlling combustion. Write for complete details or contact your nearby Republic field engineer.

REPUBLIC FLOW METERS CO.



Republic Automatic Combustion Controls

At Carter Oil Company • Billings, Montana

The boiler plant for Carter Oil Company's modern refinery at Billings, Montana is operated for maximum efficiency by a complete Republic control system for combustion, feed-water and desuperheating. Automatic combustion controls are coordinated with feedwater and desuperheater controls to enable the boilers to meet all load changes smoothly.

The plant consists of four boilers, each rated at 42,000 pounds of steam per hour. Total steaming rates average 125,000 pounds per hour. The boilers are gas fired with oil as standby. Both fuels may be fired simultaneously, if desired.

Looking down the firing aisle of the Billings refinery in the photograph above, Republic control panels for the boilers are at right. Located at the left of each panel are Republic regulators which send control impulses to positioners of fuel valves and fans. Feedwater regulators are also located with the combustion regulators.

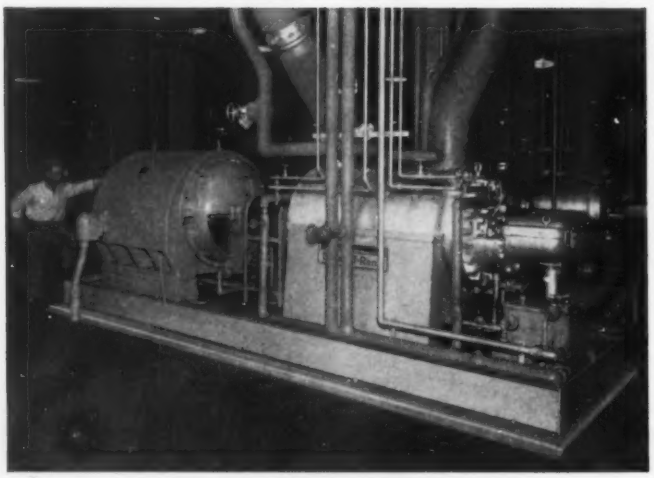
2240 Diversey Pkwy., Chicago 47, Illinois

Contributing to the

of New England Electric System's

Ingersoll-Rand

CONDENSERS AND ACCESSORIES
BOILER FEED PUMPS
GENERAL SERVICE PUMPS
SOOT BLOWING COMPRESSORS



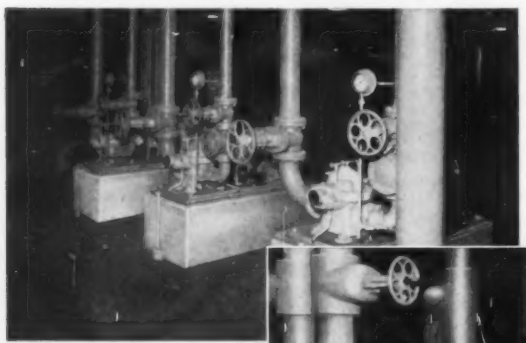
One of six Ingersoll-Rand 9-stage double-case boiler feed pumps serving the Salem Harbor Station. A 4th stage take-off delivers 778 gpm at 2170′ total head for attemperating service. The last 5 stages deliver 730 gpm at 2620′.

New England Electric System's Salem Harbor Station at Salem, Mass. is a fine example of the best in modern central station design. New England Power Service Company and United Engineers and Constructors, Inc. collaborated on the station's design, the latter firm doing the construction.

This station combines high operating economy with maximum continuity of service. That calls for *proved* economy and dependability in every item of equipment in this 150,000 kw plant.

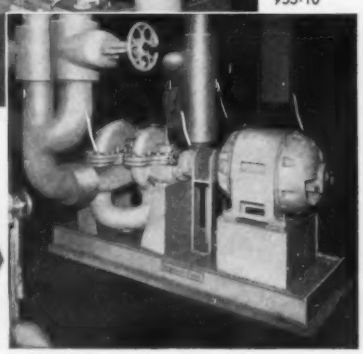
That's why Ingersoll-Rand is pleased to have been called on to supply so much of the auxiliary equipment serving both units at Salem Harbor Station. Major items of this equipment are shown in the accompanying photos.

For *dependability*, operating economy and low maintenance, it pays to install Ingersoll-Rand central station auxiliaries.



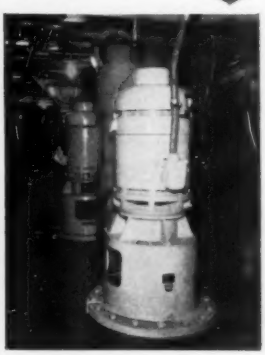
Three I-R single-stage general service pumps supply cooling water for various station equipment.

955-10

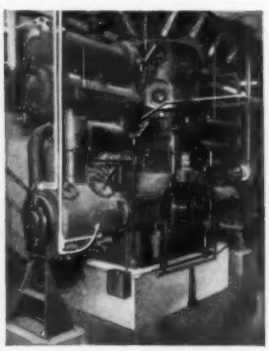


This I-R two-stage pump, rated at 1500 gpm and 270′ total head, is on city water booster service.

Two I-R two-stage, vertical turbine pumps handling service water.



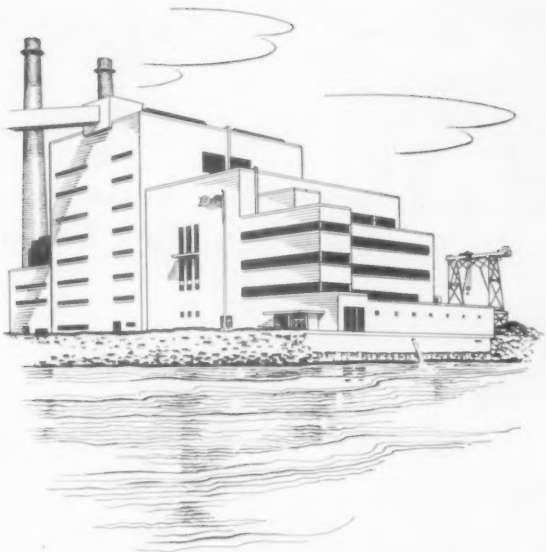
One of three I-R Class TVH 3-stage, 500 psi soot blowing compressors.

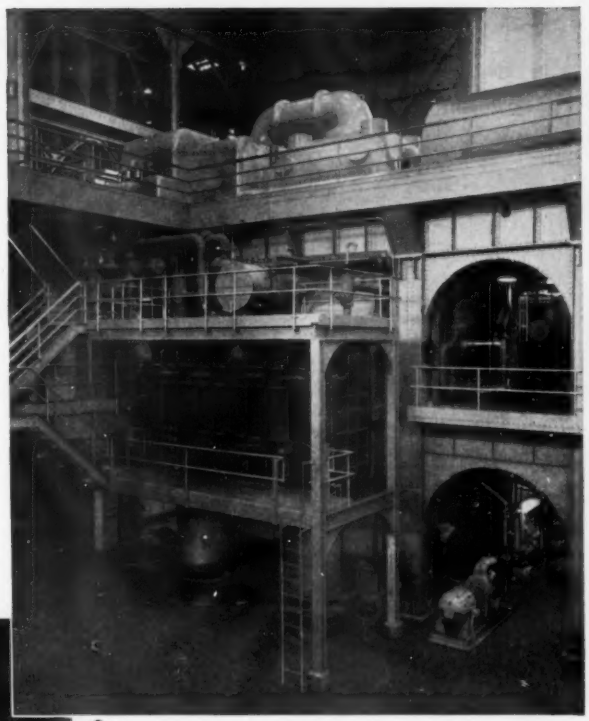


Ingersoll-Rand
Cameron Pump Division
11 Broadway, New York 4, N. Y.

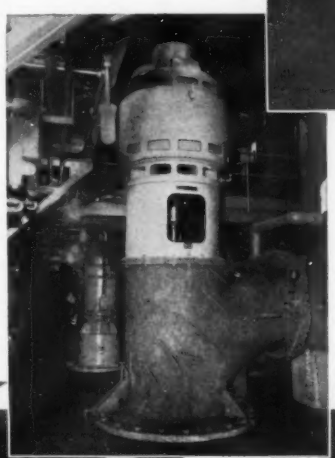
Dependability

SALEM HARBOR STATION



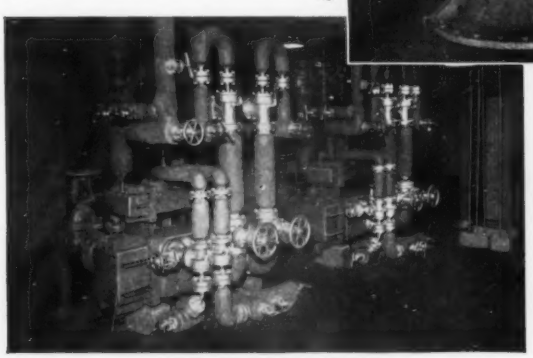


Unit 2 of the Salem Harbor Station, showing the 47,500 sq. ft. I-R rectangular steam condenser under the 75,000 kw turbo-generator. A duplicate condenser serves Unit 1.

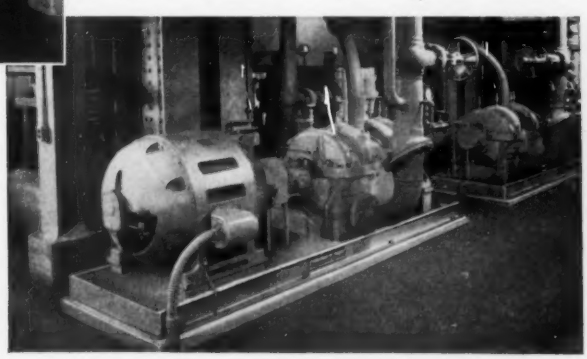


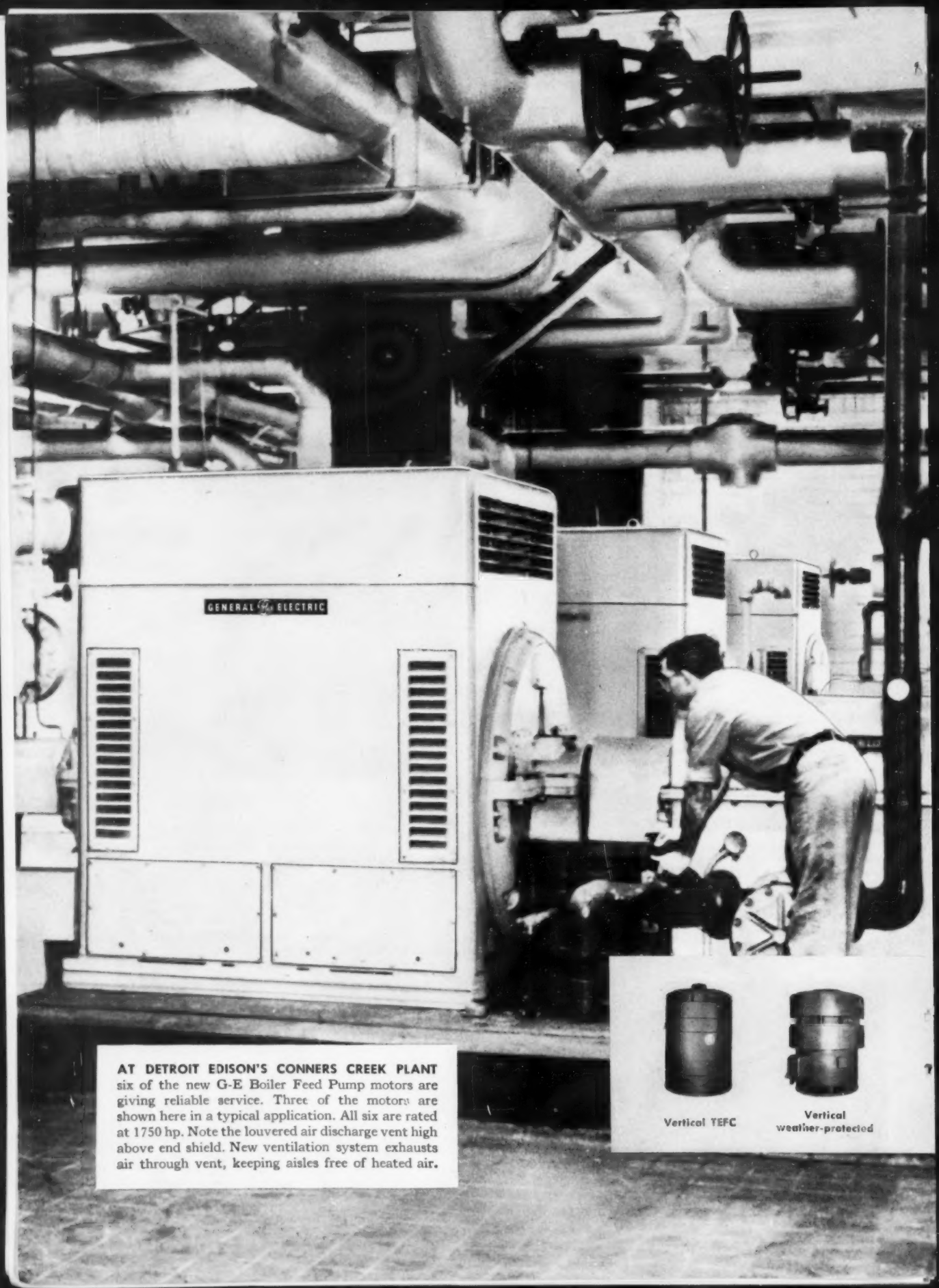
One of four I-R single-stage vertical condenser circulating pumps which each deliver 54,000 gpm to the condensers at Salem Harbor.

These two-stage steam jet air ejectors remove non-condensables from the steam condenser for Unit 2.



Two of the four I-R horizontal condensate pumps which serve the two condensers at the Salem Harbor Station. Each pump is rated 1,000 gpm, 465′ total head and 1180 rpm.





AT DETROIT EDISON'S CONNERS CREEK PLANT six of the new G-E Boiler Feed Pump motors are giving reliable service. Three of the motors are shown here in a typical application. All six are rated at 1750 hp. Note the louvered air discharge vent high above end shield. New ventilation system exhausts air through vent, keeping aisles free of heated air.

Vertical TEFC

Vertical weather-protected

General Electric Boiler Feed Pump Motor Features Unique Ventilation System

Well-integrated bearing design means longer motor life

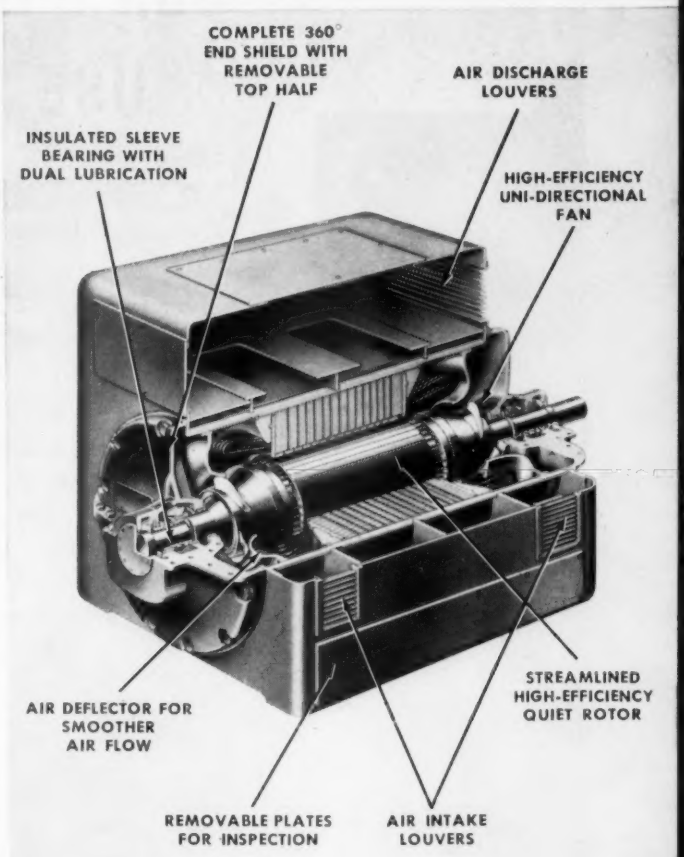
General Electric's Boiler Feed Pump motor, field proved in power stations across the country, has a revolutionary ventilation system which helps prevent recirculation of heated discharge air. Air, drawn in through the sides of the motor, is discharged high over the pump and away from aisles and employees. This means motors can be mounted closer together and still get proper ventilation.

QUIET OPERATION is assured because the G-E Boiler Feed Pump motor is designed for minimum inherent noise. In addition, these motors can be modified to meet specific sound level requirements.

LONGER BEARING LIFE means motors last longer, and the bearing system of G-E Boiler Feed Pump motors is designed for the reliable year 'round operation so vital to your industry.

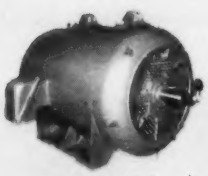
- Dual lubrication system, both ring and force-flood, assures thorough lubrication and cool bearing oil.
- Amply proportioned bearings provide even distribution of stress. Bearings are insulated to prevent circulation of shaft currents.
- Soft-metal labyrinth seals are carefully machined to keep dirt out, oil in.

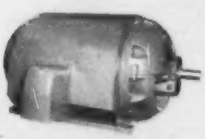
WHATEVER YOUR NEEDS in power station motors, General Electric can furnish a complete line—a wide variety of designs and enclosures to meet every operating condition. For more information on G.E.'s Boiler Feed Pump motor (Bulletin GEA-5813) or any of the complete line of power station motors consult your nearest Apparatus Sales Office, or write General Electric Company, Section 830-11, Schenectady 5, N.Y.

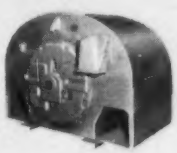

COMPLETE 360° END SHIELD WITH REMOVABLE TOP HALF
AIR DISCHARGE LOUVERS
INSULATED SLEEVE BEARING WITH DUAL LUBRICATION
HIGH-EFFICIENCY UNI-DIRECTIONAL FAN
AIR DEFLECTOR FOR SMOOTHER AIR FLOW
STREAMLINED HIGH-EFFICIENCY QUIET ROTOR
REMOVABLE PLATES FOR INSPECTION
AIR INTAKE LOUVERS

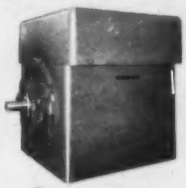
CUTAWAY OF NEW G-E BOILER FEED PUMP MOTOR

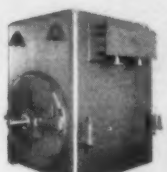
A COMPLETE LINE OF MOTORS FOR POWER STATION SERVICE

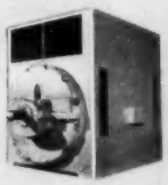

Totally-enclosed fan-cooled


Open drippproof


Grade-mounted weather-protected


Base-ventilated weather-protected

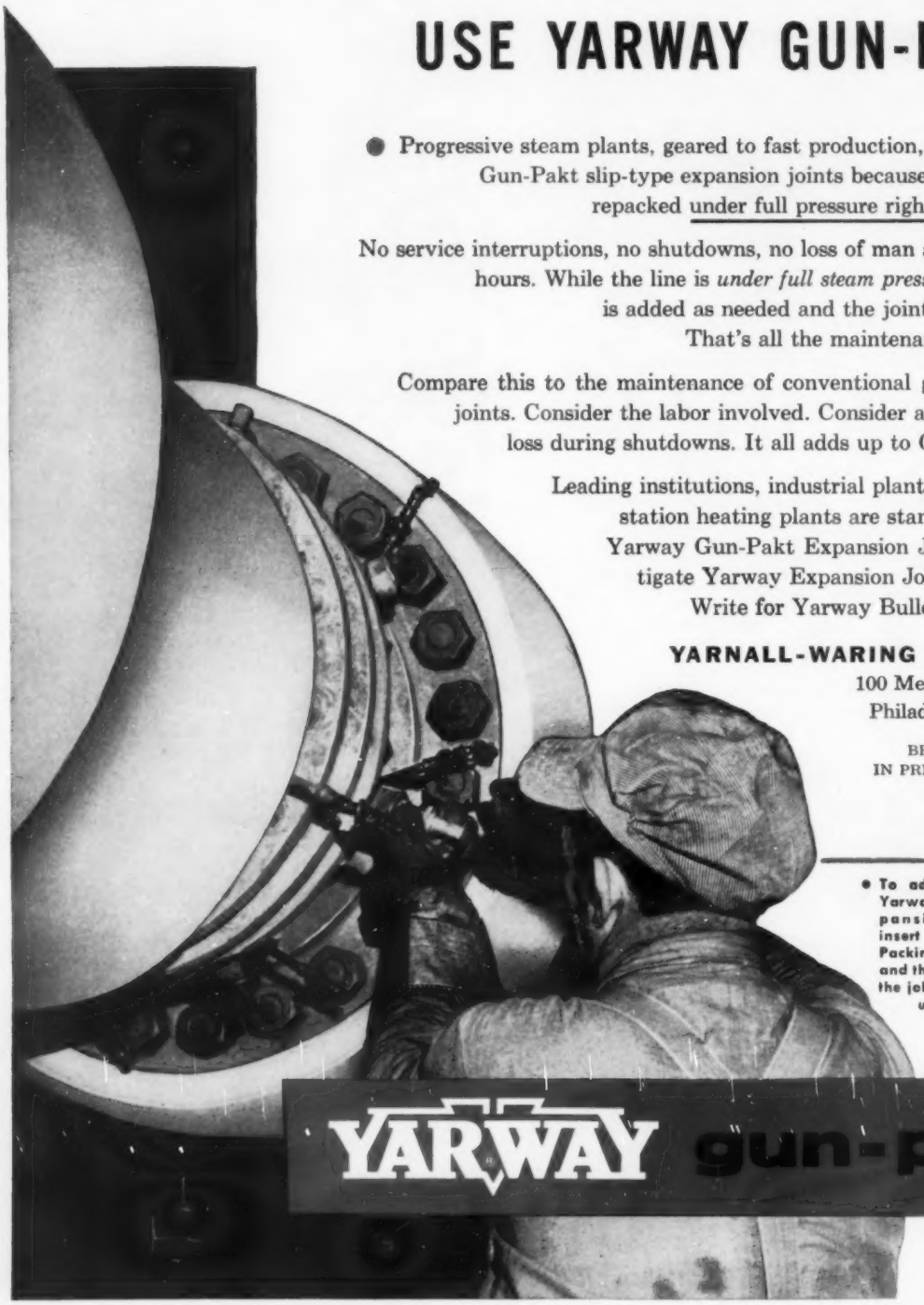

Totally-enclosed air-water cooled


Boiler feed pump

GENERAL ELECTRIC

going places?

DON'T BOTHER TO UNPACK..
USE YARWAY GUN-PAKT



● Progressive steam plants, geared to fast production, use Yarway Gun-Pakt slip-type expansion joints because they can be repacked under full pressure right on the job.

No service interruptions, no shutdowns, no loss of man and machine hours. While the line is *under full steam pressure*, packing is added as needed and the joints lubricated. That's all the maintenance required.

Compare this to the maintenance of conventional gland-packed joints. Consider the labor involved. Consider also the profit loss during shutdowns. It all adds up to GUN-PAKT.

Leading institutions, industrial plants and central station heating plants are standardizing on Yarway Gun-Pakt Expansion Joints. Investigate Yarway Expansion Joints yourself. Write for Yarway Bulletin EJ-1913.

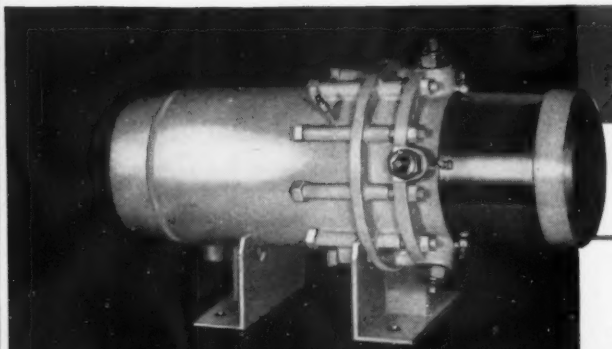
YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Pa.

BRANCH OFFICES
IN PRINCIPAL CITIES

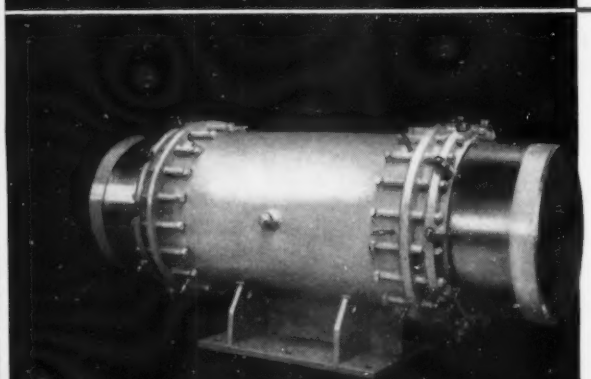
● To add packing to a Yarway Gun-Pakt Expansion Joint, just insert Yarway Plastic Packing, twist a wrench and the joint is tight . . . the job done. *There is no unpacking operation.*

YARWAY gun-pakt

EXPANSION JOINTS



Single end, welding-type Yarway Gun-Pakt Expansion Joint with base for pressures to 300 psi. 12 inch traverse.



Double end, welding type Yarway Gun-Pakt Expansion Joint with base for pressures to 300 psi. 24 inch traverse.

compare these maintenance records

	YARWAY GUN-PAKT JOINTS	CONVENTIONAL GLAND-PACKED JOINTS
STATE UNIVERSITY*	Required addition of only 3 slugs (45 cents) of packing in 5 years. Lubrication only once every 6 months. Total labor time of only 2 manhours in 5 years.	Same lubrication as Gun-Pakt, *plus* gland tightening, *plus* complete overhaul with shutdown for unpacking and repacking every 3 to 4 years. Time for overhaul—25 manhours per joint!
MID-WEST AIRFIELD*	Only maintenance was lubrication and addition of 2 slugs (30 cents) of packing per year. Total labor ¼ manhour per joint per year.	Lubrication and gland tightening required 8 manhours per joint per year—plus complete unpacking and overhaul every 2 to 3 years. Time required for overhaul—20 manhours per joint.
"BIG TEN" UNIVERSITY*	Lubrication only once every 2 months, with packing added as needed. Total labor time charged, 1 manhour per joint per year.	General maintenance requires 6 manhours per joint per year. Complete overhaul required every 2 to 3 years with unpacking and repacking—24 manhours per joint.

*Names on request

expansion joints

OTHER YARWAY PRODUCTS

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
LIQUID LEVEL INDICATORS
IMPULSE STEAM TRAPS
FINE SCREEN STRAINERS
SPRAY NOZZLES
DIGESTER VALVES
HYDRAULIC VALVES

CONTRACTING DIVISION

MIDWEST PIPING COMPANY, Inc.

ST. LOUIS, MISSOURI

JOB No. C-3550 — LINE SKETCH. — DATE MAR 6, 1953

NAME WABASH RIVER STATION — OWNER PUB. SERV. CO. IND. — LOCATION TERRE HAUTE, IND

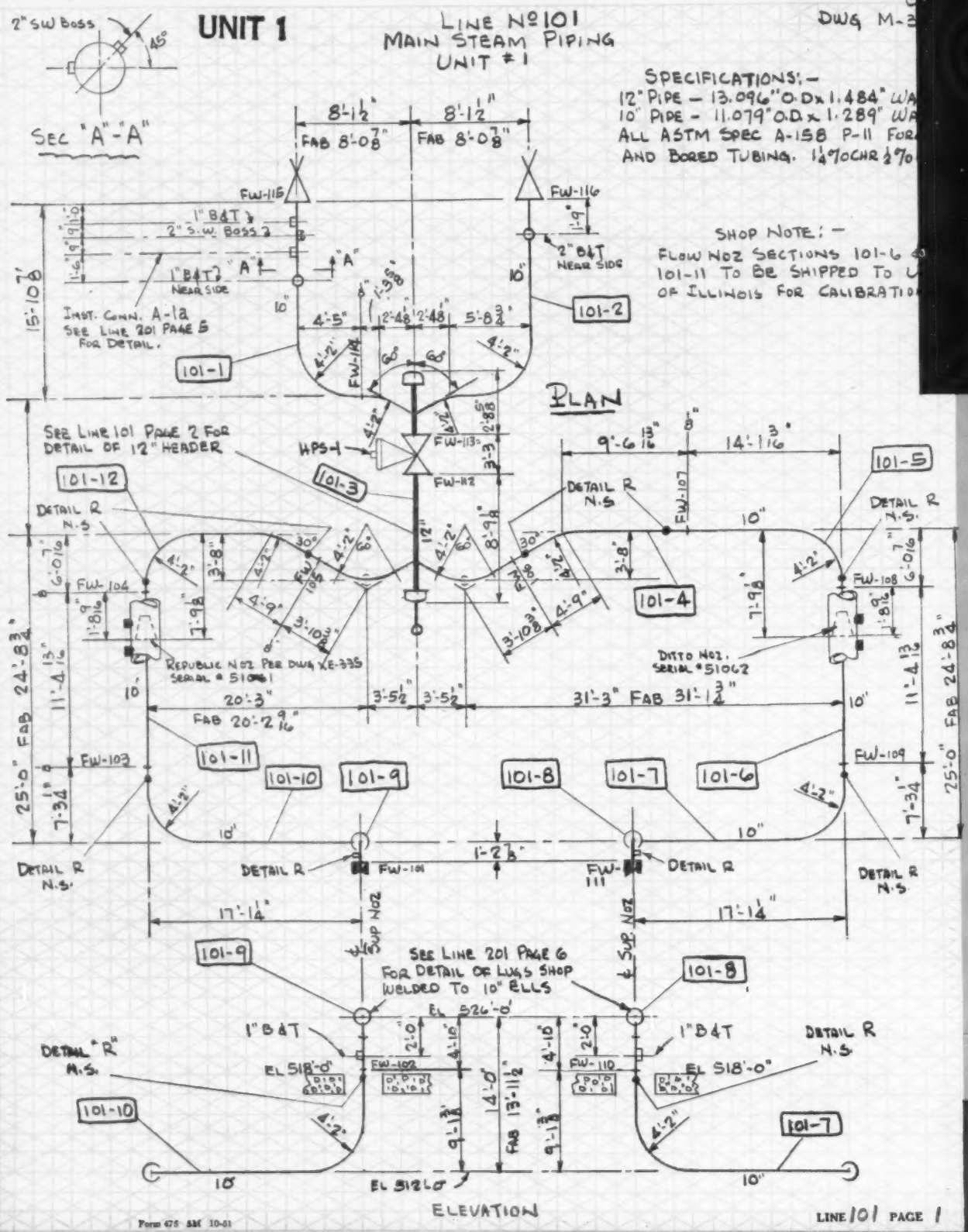
UNIT 1

LINE No 101
MAIN STEAM PIPING
UNIT #1

DWG M-3

SPECIFICATIONS:-
12" PIPE - 13.096" O.D x 1.484" WA
10" PIPE - 11.079" O.D. x 1.289" WA
ALL ASTM SPEC A-158 P-11 FOR
AND BORED TUBING. 1¼%CHR ½%

SHOP NOTE:-
FLOW NOZ SECTIONS 101-6 &
101-11 TO BE SHIPPED TO
OF ILLINOIS FOR CALIBRATIO



Field Erection Sketches like this HAVE Important Advantages to Users of MIDWEST PIPING

Reproduced on the page at left (about ¾ actual size) is a Field Erection Sketch typical of those prepared for all piping installed by our Contracting Division. These sketches have very real advantages for the customer.

These sketches are made by our skilled piping engineers who are thoroughly familiar with both shop fabrication and field erection. Each line is divided into a series of subassemblies that minimize and simplify the field welding . . . the difficult work is done in our well-equipped fabricating shops. Each fabricated subassembly has an individual piece mark number for easy field identification and correct sequence of erection. The fabricated subassemblies are shipped to the job in that order.

All planning has been done by our engineering staff . . . which reduces field thinking and eliminates guesswork. Erection is from these sketches instead of from the design engineer's drawings . . . this speeds up the work and results in a real cost saving and earlier completion of the job.

These Field Erection Sketches provide much essential detail that is never expected of the designer. They serve as a check of the design engineer's drawings and if discrepancies occur they are disclosed before fabrication instead of during erection.

The preparation of these Field Erection Sketches requires careful analysis of the job which often suggests changes that simplify and streamline the piping design and reduce costs in the shop and in the field.

Consequently, the customer gets a better piping job at minimum cost . . . which is why you will find it to your advantage to call in Midwest whenever you have a piping job.

MIDWEST PIPING COMPANY, INC.

Main Office, 1450 South Second St., St. Louis 4, Mo.

PLANTS: ST. LOUIS, PASSAIC, LOS ANGELES, and BOSTON

SALES OFFICES: NEW YORK 7—50 CHURCH ST. • BOSTON 27—426 FIRST ST.
LOS ANGELES 33—520 ANDERSON ST. • CHICAGO 3—79 WEST MONROE ST.
CLEVELAND 14—616 ST. CLAIR AVE. • HOUSTON 2—1213 CAPITOL AVE.
TULSA 3—224 WRIGHT BLDG.

6497

MIDWEST

PIPING FABRICATION and CONSTRUCTION

OFFERS YOU MANY BENEFITS

WORTHINGTON DC-2 COMPRESSORS are installed in the Libbey-Owens-Ford Glass Company's Fiber-Glass plant in Parkersburg, West Virginia. They have five-step variable capacity controls enabling them to operate with a minimum power consumption.

Compressed air helps turn a single glass marble into 42 miles of textile filament!

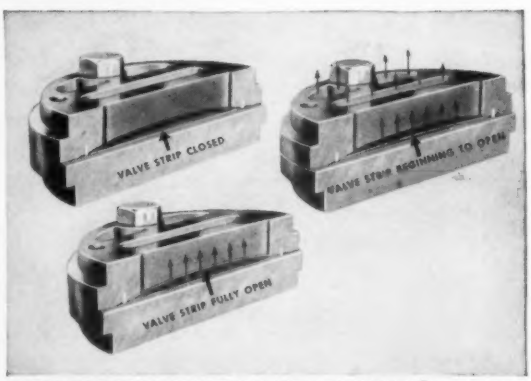
Libbey-Owens-Ford uses Worthington compressors in the manufacture of fiber glass

Daily, more than 40 million miles of filament, gathered into strands of fiber glass, twisted into yarns, and woven into industrial cloth, tape and other textile forms, are produced at the Libbey-Owens-Ford plant at Parkersburg, West Virginia.

The fiber glass filament is made by melting specially prepared glass marbles in small furnaces and drawing the glass through the minute apertures of a "bushing". Humidity is important in handling these continuous fibers of glass and compressed air is used to maintain accurate man-made weather. Compressed air is actually used in 22 important operations in making fiber glass in this ultra-modern factory.

Three Worthington DC-2 compressors, each with five-step capacity control, supply the air pressure required in these many delicate tasks.

Whatever your requirements for compressed air, Worthington builds compressors to meet them. Write us about your compressor problems. Worthington Corporation, Compressor Division, Section K.4.1, Buffalo, N.Y.



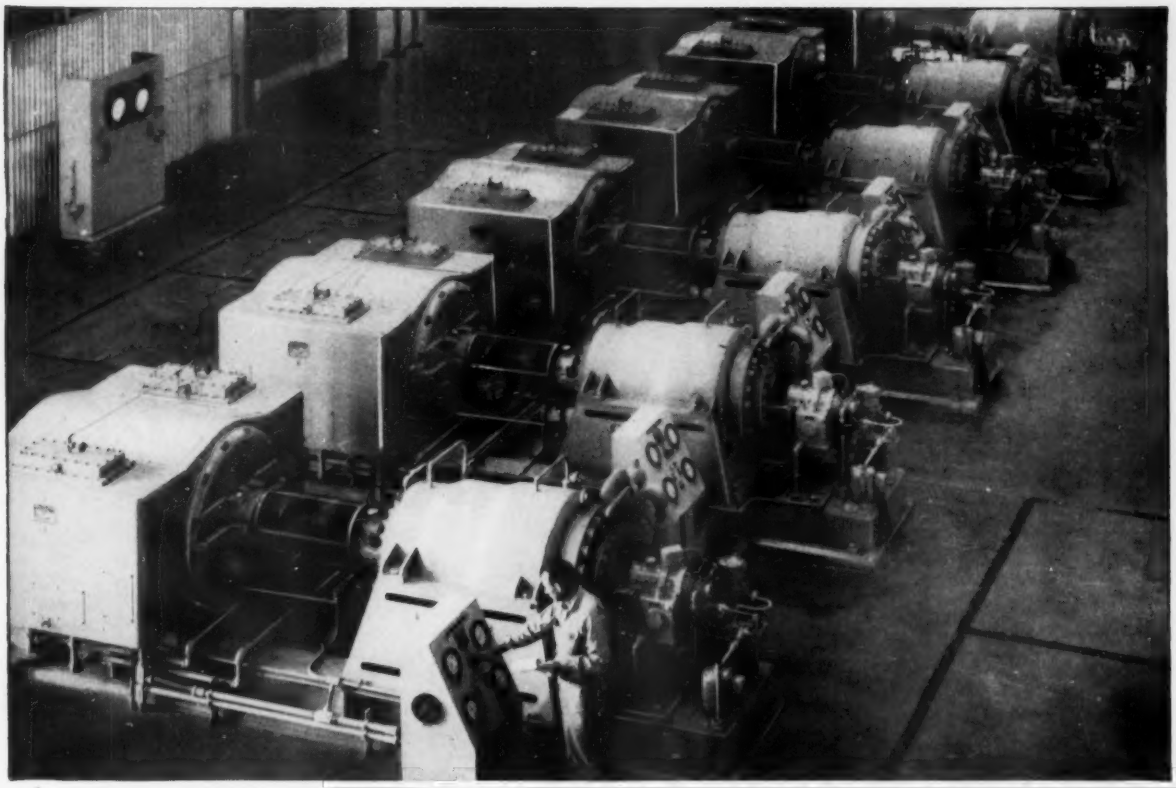
WORTHINGTON'S EXCLUSIVE FEATHER* VALVE lowers compressor fuel consumption. A series of thin flexible strips of ribbon steel lift and flex uniformly as shown. This lightest, tightest, most durable valve ever made is standard on all Worthington compressors. *Reg.U.S.Pat.Off.

K.4.1

WORTHINGTON

Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors



SIX WORTHINGTON HIGH-PRESSURE BOILER FEED PUMPS on the job at the Contra Costa Steam Plant of the Pacific Gas and Electric Company. Each pump delivers 500,000# per hour at a discharge pressure of 1,800 psig.

What should you look for in a high-pressure* boiler feed pump?

We think we're qualified to answer that. Back in 1923 we built our first high-pressure centrifugal boiler feed pump, and we've had a lot of experience making them since.

Here are some of the features you should look for:

All pressure joints should be *metal-to-metal ring type joints,* universally accepted as the proper construction for high-pressure service.

Inner assembly should be firmly anchored to the casing barrel at the inboard end, but *free to expand* under temperature changes at the outboard end without destroying perfect centering of running joints and bearing support.

Internal joints constructed so that hydraulic pressure acts to seal joints, rather than open them. Only in pumps of this design can the tightness of the internal joints be hydraulically tested during the process of assembly.

Pump casing made of forged steel, the same material that is selected for all high-pressure fittings and valves.

Centerline support of casing should allow for temperature changes with minimum distortion.

"Volute-passage" diffuser to eliminate narrow diffuser passages and a multitude of diffuser vanes.

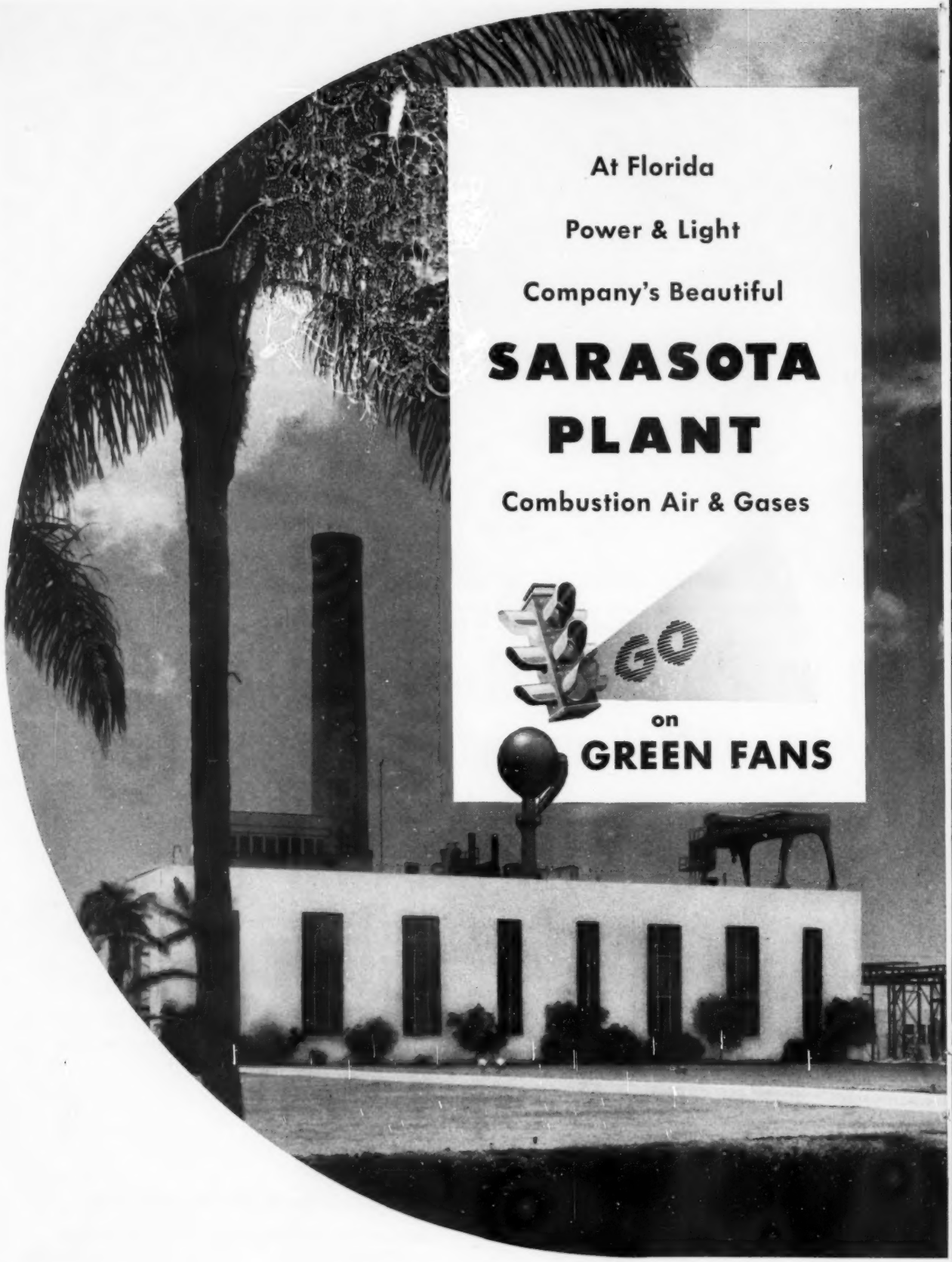
All of these, by the way, are standard on Worthington high-pressure boiler feed pumps. And our customers are pretty happy about it, too.

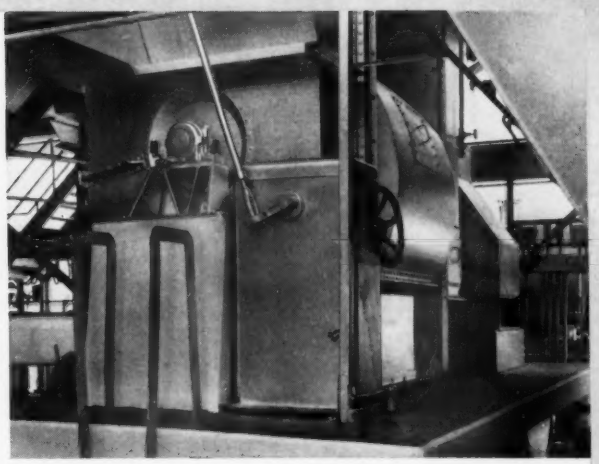
Ask for our Bulletin W319B-1C. Write Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey. *Over 1300 psi. C.3.12

WORTHINGTON

The World's Broadest Line Assures You the Right Centrifugal Pump for Every Job

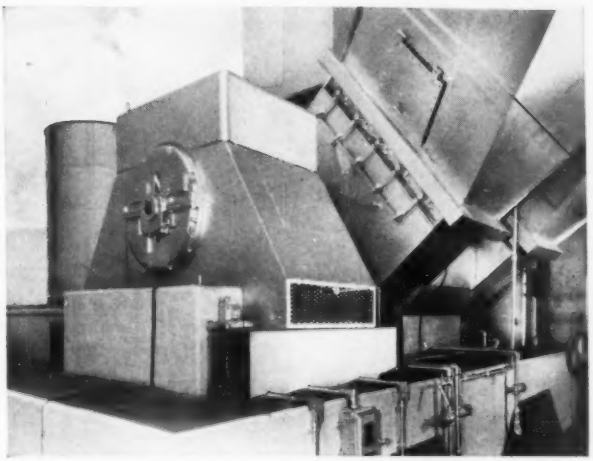
Boiler Feed Normal Service • **Hotwell, Condensate, Chilled Water** • **Water Works, Circulation, Drainage, General** • **Boiler Feed High Pressure Service**


At Florida
Power & Light
Company's Beautiful
SARASOTA
PLANT
Combustion Air & Gases
GO
on
GREEN FANS



GREEN
FORCED DRAFT FAN

A GREEN Forced Draft Fan installed at Sarasota. This Green Fan No. 56 RB 3615 BD is driven by a 200 HP Electric Motor, and delivers 79,800 CFM air at 100°F.



GREEN
INDUCED DRAFT FAN

This GREEN Induced Draft Fan delivers 132,000 CFM of Gas at 365°F at the Sarasota Plant. It is Green Fan No. 51 MC 3202 D and is driven by a 400 HP Electric Motor.

Keeping pace with the demand for more power occasioned by the tremendous growth of Florida's population and industry, Florida Power & Light Company is now engaged in a $332,000,000, ten-year expansion program. One phase of this program is the expansion of the Sarasota Plant.

When it came time to specify forced and induced draft fans for Sarasota, they picked GREEN. F. P. & L. has operated GREEN FANS in other plants in its system for a number of years.

There are hundreds of other similarly satisfied customers throughout the country.

Send for our Fan Bulletin 168. If interested in Fuel Economizers ask for Bulletin 169. Our Aerodyne Dust Collectors are described in Bulletin 170. All are yours for the asking.

The Green Fuel Economizer Company, Inc.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS • AERODYNE DUST COLLECTORS

When you need instrument service . . .

Ever have a tire blow out while you're traveling late at night? If it happens near a service station, you're lucky. But if it's on a lonely road far from town, you've got trouble.

When it comes to service on instruments, you don't need to take chances on being lucky. Because when you have Honeywell instruments, you've always got the comfortable feeling that service is close at hand . . . whenever and wherever you want it . . . from the world's biggest instrument service organization.

OVER 110 SERVICE CENTERS

No matter where you may be, there's a Honeywell service man near you. Offices are located in more than 110 cities of the United States and Canada, near every large production center.

When you run into trouble, just telephone or wire the nearest of these offices. You'll get a service specialist promptly . . . often within a few hours. This quick attention to your needs protects your production schedules, and prevents delays that can cause costly stoppages.

TRAINED PERSONNEL

Honeywell service men are thoroughly trained for their important responsibilities. In the Honeywell factories, hand-picked men learn both the theory and practice of instrument maintenance. Then they serve an apprenticeship in the field offices, to gain further first-hand experience. You can be sure that the Honeywell man who calls at your plant is a qualified specialist, well versed in the practical art of keeping good instruments in the best condition.

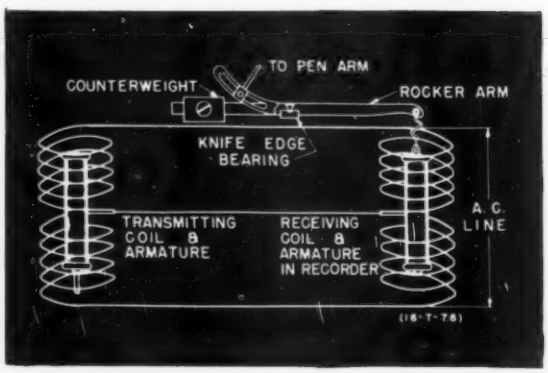
PERIODIC SERVICE

But why wait for emergencies—when you can prevent them with periodic service. Under a simple contract, a Honeywell man will visit your plant at regular intervals to inspect, clean and adjust your instruments and controls. The plan is economical, and can save you hours of production time. Our nearby office will be glad to give full details on Honeywell Periodic Service.

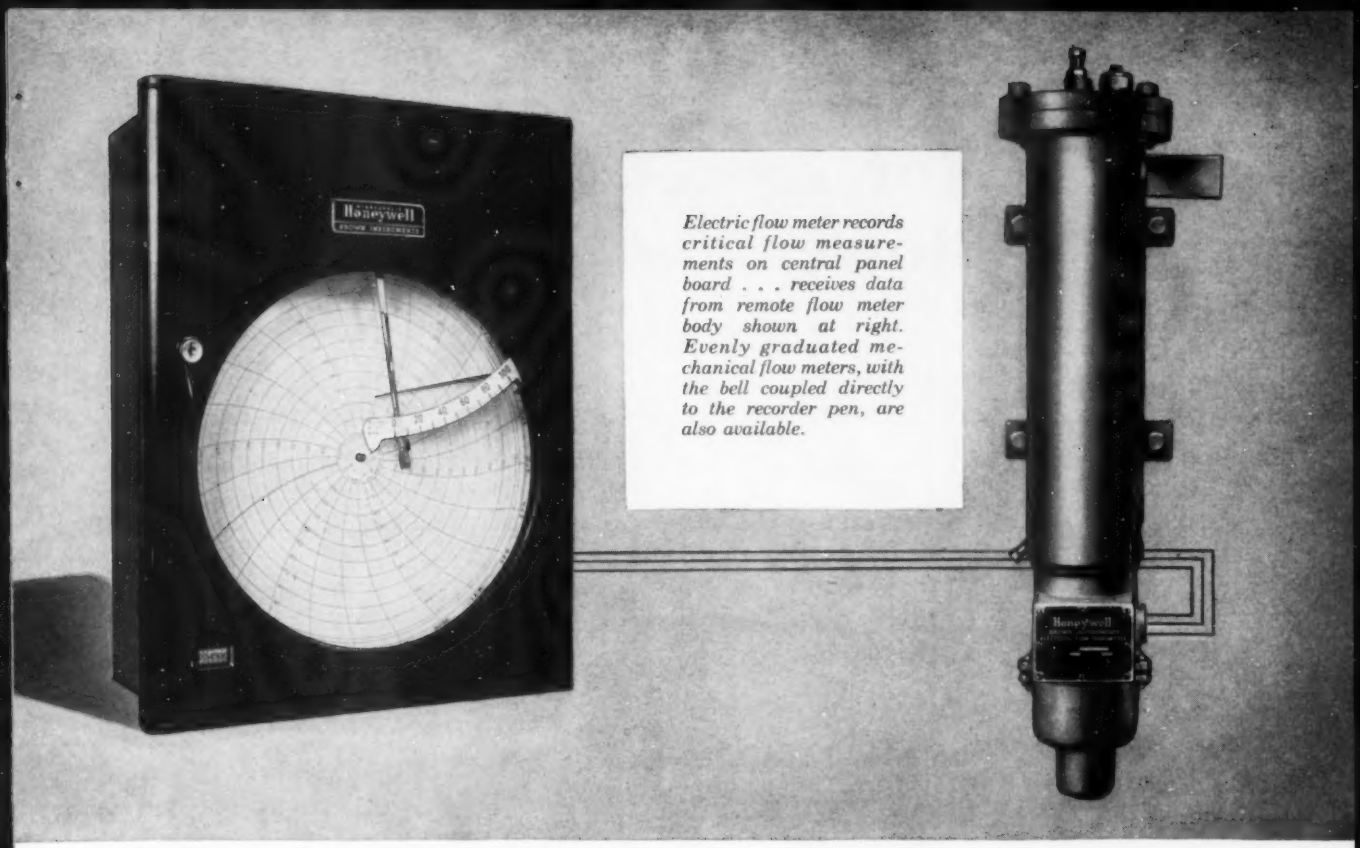
Better accuracy...

greater simplicity

.....for steam



ELECTRICAL TRANSMISSION SYSTEM *brings flow data instantaneously and accurately from the remote meter body to the Brown Flow Meter. The inductance bridge system consists of a transmitting coil and armature at the meter body, and an identical coil and armature in the instrument. The receiving armature faithfully duplicates the movement of the transmitter.*



Electric flow meter records critical flow measurements on central panel board . . . receives data from remote flow meter body shown at right. Evenly graduated mechanical flow meters, with the bell coupled directly to the recorder pen, are also available.

plant flow measurements

WHEREVER your steam plant uses measurement of flow . . . for steam, feedwater, make-up water or oil . . . Brown Electric Flow Meters offer every performance feature you could require. Compare these advantages:

Electronic integration . . . using high-speed, high-sensitivity electronic scanning . . . provides exceptional precision in totalizing flow. This unique integrator completely eliminates friction loading of the recording system. It's extremely simple; has only three major parts, and can be calibrated in only a few minutes.

Electrical transmission . . . ideal for centralized control . . . permits the meter body and instrument to be located hundreds of feet apart without loss of sensitivity. A precision-made inductance bridge transmission system (illustrated on the opposite page) gives faithful reproduction of remote measurements, and eliminates the problems of panel pipe connections.

Evenly divided chart assures easy readability and high accuracy at all flow values . . . no crowding of divisions at the low end of the scale.

Brown Electric Flow Meters are available in both square root and evenly graduated type meters with ranges applicable to practically all steam, water and oil measurements. Your nearby Honeywell sales engineer will welcome the opportunity to discuss your specific needs . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for new Catalog 2320, "Flow Meters, Indicating, Recording, Controlling."

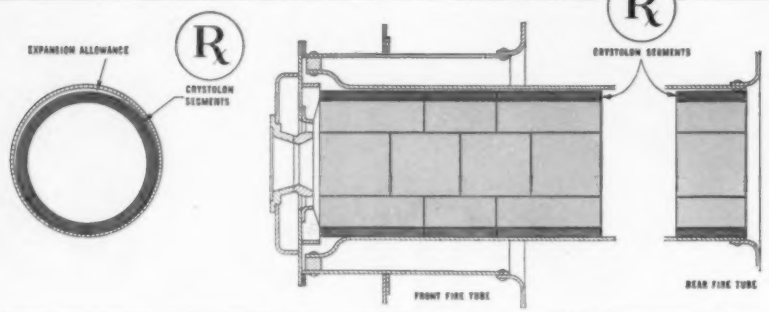
MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

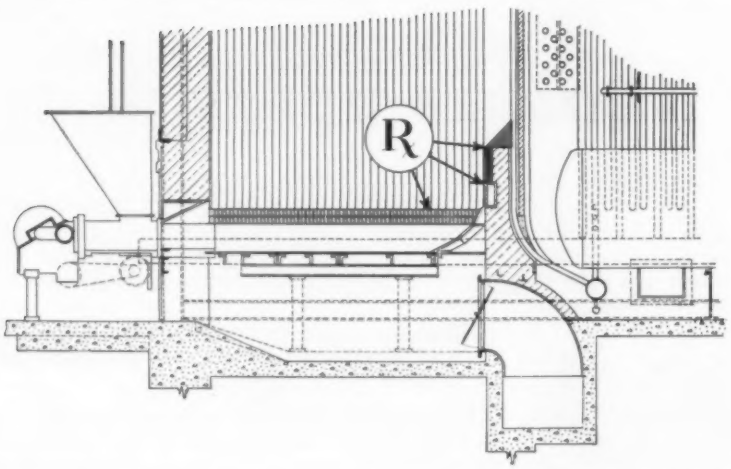
Rx for more efficient, lower cost operation of packaged boilers

Norton CRYSTOLON* refractories are engineered for maximum boiler protection and prescribed for toughest service conditions



Fire Tube Packaged Boilers

CRYSTOLON segmental linings support combustion in the fire tube and protect the metal jacket. Use tongue-and-grooved segments for smaller sized boilers, arch brick for larger boilers.



Water Wall Packaged Boilers

CRYSTOLON armor block at the grate level overcomes the severe abrasive action of fuels and clinker formations. Brick and air setting cement of this same highly refractory material give added protection to the bridge wall.

Norton CRYSTOLON refractories, *engineered and prescribed* for better boiler performance, are characterized by exceptional hot strength, high refractoriness and thermal conductivity and great resistance to slag penetration, spalling and abrasion. Providing maximum protection against the mechanical and chemical attacks of a wide variety of fuels, they eliminate many costly repairs to grates and settings, as well as reducing downtime and maintenance costs to new lows.

Get this new booklet

describing how Norton refractories supply money-saving Rx's for your boiler application. Write for your copy of *Refractories for Heat and Power* to NORTON COMPANY, 447 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Company, Ltd., Toronto 5, Ontario.

NORTON

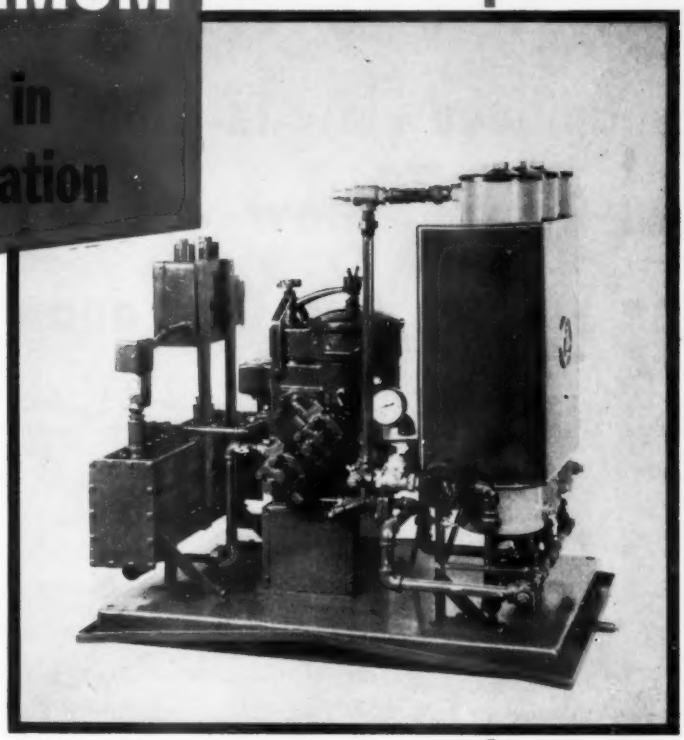
REFRACTORIES

Engineered... Rx... Prescribed

Making better products... to make other products better

*Trade-Mark Reg. U.S. Pat. Off. and Foreign Countries

"DE LAVAL" MEANS "MAXIMUM PROTECTION" in Diesel Lube Purification



When De Laval "Puri-Filters" stand guard over your Diesels you can be absolutely sure that you are meeting these two basic requirements!

(1) *Thoroughly* removing both solid and liquid contaminants: dirt, water and colloidal carbon . . .

(2) Doing so *continuously*—with 24-hour per day dependability, day after day, month after month, even year after year.

The record of De Laval "Puri-Filters" is outstanding. That is why you will see De Laval "Puri-Filters" on guard in so many of the most efficient Diesel-equipped plants and aboard so many Diesel-powered vessels.

Complete protection plus *continuous* protection is *maximum* protection—DE LAVAL PROTECTION—the only kind you should have for your Diesels.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York ● 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5

DE LAVAL

LUBRICATING OIL FILTERS

Only Edward Offers Streamlined Flow

From 1/4" to 16"....Edward Gives You Streamlined Flow in Globe, Angle, Check, Non-Return, Blow-Off, Gate and Feed Line Valves...in Cast and Forged Steel!

In today's trend to higher pressures and temperatures, with resulting increased erosion, streamlined flow plays an even bigger role in keeping valve operating and maintenance costs down . . . and system efficiency high.

Pioneered by Edward—developed after years of extensive flow tests and experiments with plastic models, prototypes, and much specially designed equipment in the largest laboratory in the world devoted exclusively to steel valve research—Edward *Streamlined Flow* offers these four outstanding advantages.

1. **Reduces wear-producing turbulence—giving longer life to seat, disk, and other moving parts.**
2. **Lower pressure drop.**
3. **Delivers maximum flow where needed.**
4. **Often permits use of smaller pipe and valve sizes.**

With Edward's broad range of valve sizes and types with streamlined flow, you can get peak valve operating efficiency . . . all-across-the-board, *wherever* valves are used. *A product of* Edward Valves, Inc., 1220 West 144th Street, East Chicago, Indiana.

Edward ...BIRTHPLACE OF BETTER VALVE DESIGNS

—IN A FULL RANGE OF VALVE SIZES

These illustrations show wear-reducing Edward streamlined flow in both small and large valves. Small valve demonstrates straight through, full flow channel of Edward Univalve. Large valve is Edward globe stop valve . . . note smooth, economical flow pattern.

Another Rockwell Product

FEATURES LIKE THIS SAVE YOU MONEY

That's why it pays to specify Edward Valves

Edward Valves, Inc.

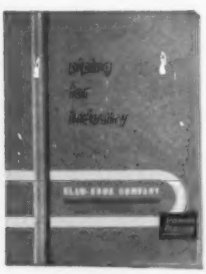
Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

fabricated and erected by Blaw-Knox

high pressure crossover piping

. . . in large power plant



To get more information on piping for industry write for your copy of Bulletin No. 2443.

Whether you need a complicated, high pressure piping system, such as this one, or a relatively simple job, you can always turn the entire job over to us. And we'll follow through . . . in close cooperation, of course, with your consultants or your own organization.

You'll get the benefit of modern shop facilities for hot and cold bending, welding and fabricating all types of piping. A metallurgical research laboratory which assures you of the latest developments in high pressure, high temperature piping. The most modern testing equipment to assure the soundness and strength of the piping.

Plus a complete service force with modern machinery for field work and erection . . . and the necessary manpower to handle jobs of any size.

What service do you require?

We will, for instance, (1) engineer, fabricate, and erect your job . . . or (2) simply fabricate and erect . . . or (3) fabricate only.

Our engineers will quote from your drawings . . . or, when desired, make a field study of your piping requirements before quoting.

Just let us know what service you want . . . and we'll provide it.

BLAW-KNOX COMPANY
Power Piping and Sprinkler Division
Pittsburgh 33, Pa.

BLAW-KNOX

POWER PIPING

Complete prefabricated power piping systems for all pressures and temperatures . . . plus complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators

Here's Help in Understanding STEAM-WATER CYCLE ANALYSES

OFTEN, constituents of deposits in steam-water cycles are reported to you in mineral names rather than chemical formulas. To help you better understand reports and analyses with these names, Allis-Chalmers has published a new Informational Bulletin, Number 59. It lists each mineral, then gives the chemical formula, the usual area in which these deposits are found, and the causes and possible preventive measures you can take.

Part of Practical Library

Only careful analysis of all the factors in the cycle can solve a specific water problem. This bulletin will help you understand, generally, the causes and solutions of a variety of water problems. It is one of a series published by Allis-Chalmers. These bulletins reflect Allis-Chalmers wide experience from years of solving water problems in every industry, in addition to solving problems involved in the company's own broad line of power plant equipment.

ALLIS-CHALMERS WATER CONDITIONING Equipment — Chemicals — Service

Complete Water Conditioning Service

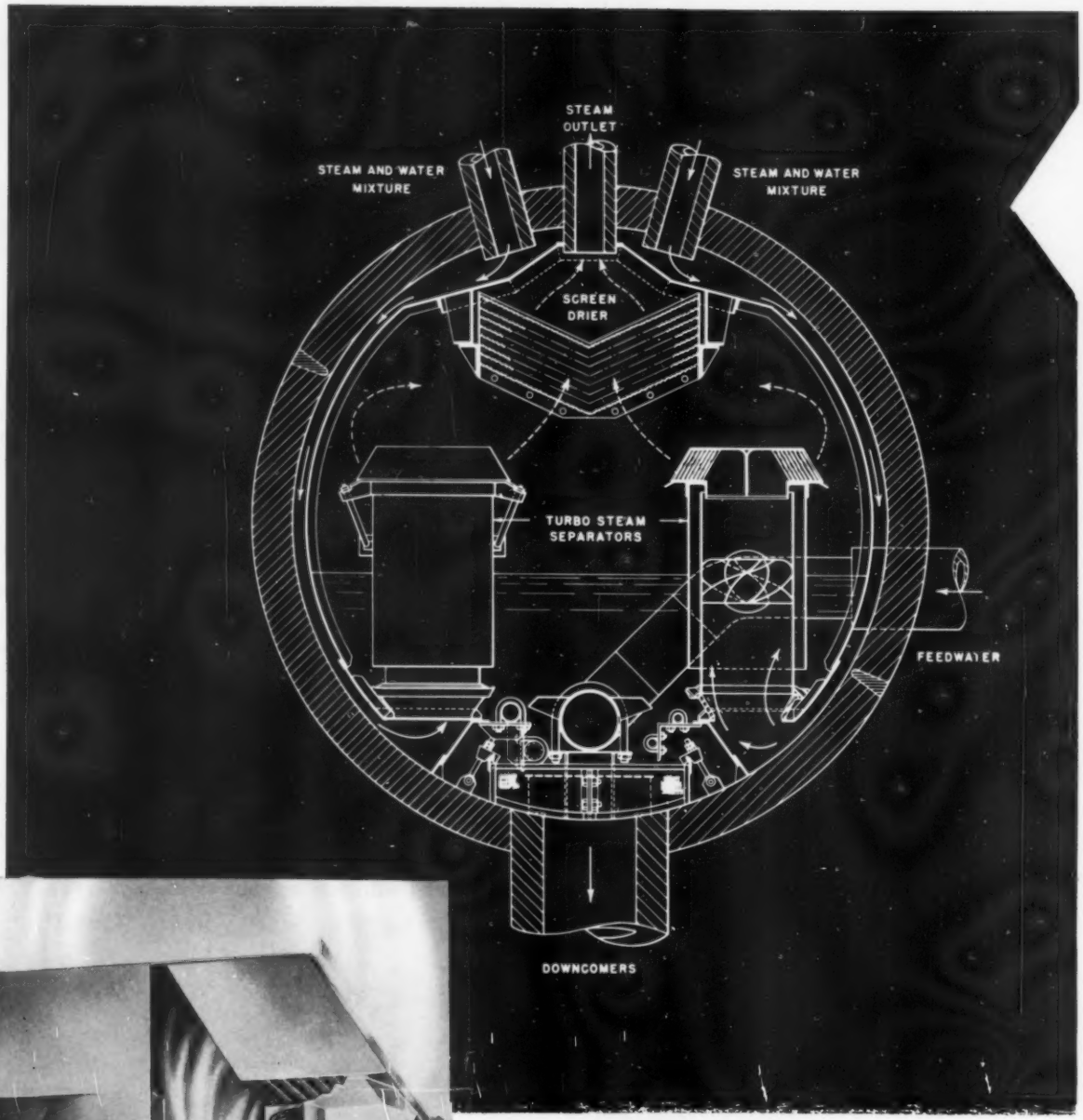
Allis-Chalmers offers complete water conditioning service. You can get analyses and reports on your problems. You can get chemicals needed for water treatment. And you can get the equipment needed for any system.

For your copy of Informational Bulletin 59 explaining the mineral names used in analyses, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby A-C office to have an Allis-Chalmers water conditioning engineer consult with you on your problem. A-4414

Complete investigative facilities at Allis-Chalmers research laboratories include this X-ray diffraction unit which is used to analyze crystalline structure of deposits from steam-water cycles.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS



How it works

Steam-water mixture enters the top of the drum through nozzles discharging into an annular space formed by internal baffles. Flow of the mixture is directed downward behind symmetrical baffles around the entire drum surface, maintaining a uniform drum-wall temperature, and then into the Turbo-Separators. The latter contain a center core and vanes which give the mixture a spinning or centrifugal motion, thereby throwing the water to the outer edges of the inner tube. Directly above the directional vanes and cores there is a skim-off lip which directs the water over the top of the inner tube and thence through the annular space to the drum. This is the primary separation stage. The relatively dry steam then passes through two opposed banks of closely spaced corrugated plates, which change the direction of the steam many times and throw out much of the remaining water. This is the secondary separation stage. The third and final stage of purification is accomplished in the screen dryer.

MEET THE TURBO–SEPARATOR

. . . the best friend a turbine ever had

To anyone concerned with the subject of steam purity and quality, boiler drum internals are of great significance. For that reason, we would like to have you meet the C-E Turbo-Separator, long an integral part of C-E Utility Boilers, but normally well concealed from view within the dark recesses of the steam drum.

The true test of any system of drum internals lies in what it can do with the combination of water, steam and solids it must handle — not alone under steady base load conditions — but under all operating conditions. Sudden load fluctuations, change in boiler water level and increased solids concentration in boiler water due to condenser leakage are three common occurrences that can greatly affect the relationship of solids to steam.

Whether the concentration of solids in boiler water averages less than 100 ppm or even more than 1000 ppm — or whether it fluctuates anywhere between — the C-E Turbo-Separator *maintains* steam purity and quality well within satisfactory limits.

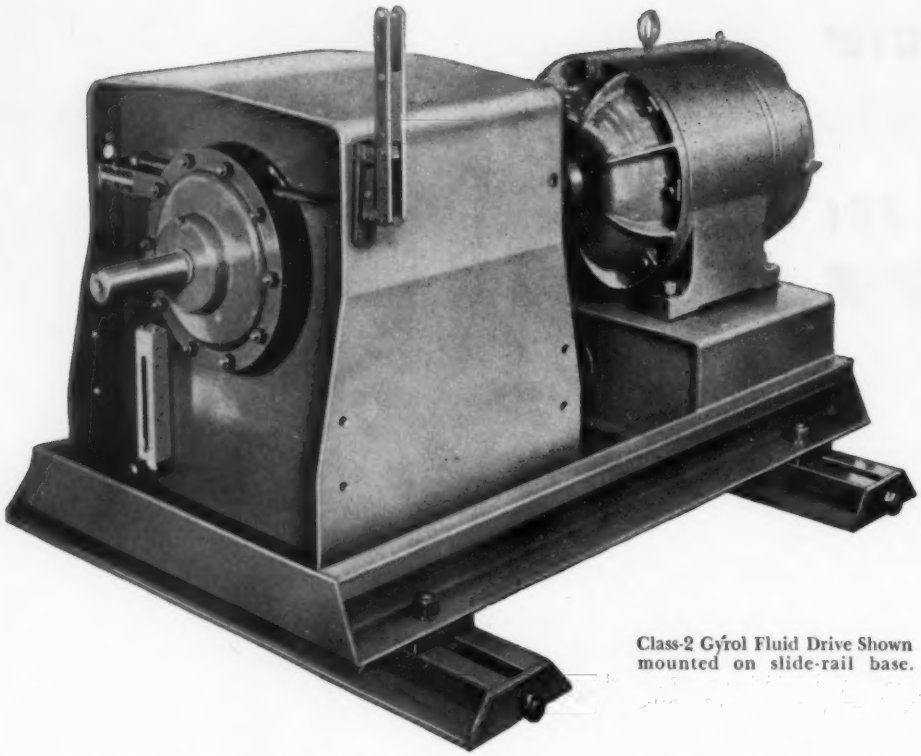
To be more specific — test results in a number of cases have shown less than .5 ppm and in some instances as low as .1 ppm. These results are supported by the fact that in no plant where Turbo-Separators are installed has there been any measurable loss of turbine capacity due to deposits on turbine blades.

When you add the proven advantages of C-E Turbo-Separators to the operating characteristics of modern designs of C-E Utility Boilers, you have the right combination for top year-around plant performance on all counts — efficiency, capacity and continuity of service. B-758

COMBUSTION ENGINEERING

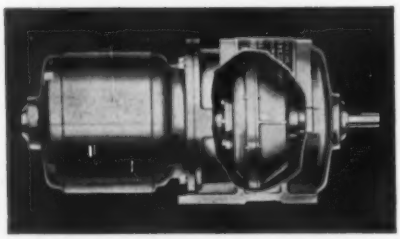
Combustion Engineering Building
200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS, AUTOMATIC WATER HEATERS; SOIL PIPE



Class-2 Gyrol Fluid Drive Shown mounted on slide-rail base.

New Gyrol fluid drive offers dual rotation,* adjustable speed



For smaller applications—American Blower TM Constant-Speed Gyrol Fluid Drive. Available in ratings from 1 to 20 hp.

Get the facts today!

Write to: American Blower Corporation, Dept. 180-6, Detroit 32, Michigan. Ask for a copy of Bulletins 9419 and 9519. They will be sent to you promptly along with any other information you may require.

Look at all these features

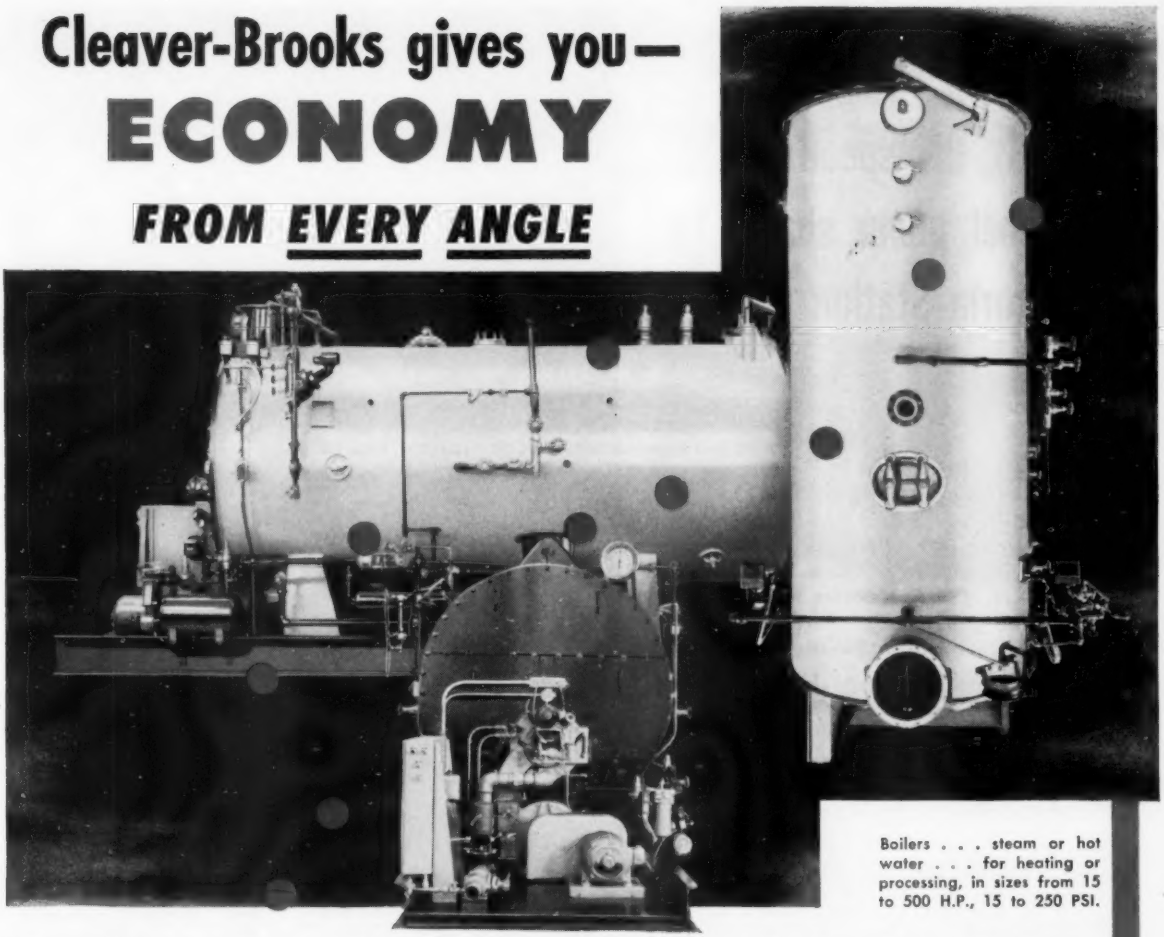
- *Can be reversed while in motion by reversing motor
- Trigger-action response—adjustable speed
- Speed range 5-1
- Permits across-the-line starting on many applications
- Motor can reach full speed before engaging load
- A compact, self-contained unit
- Speed may be controlled manually or automatically
- Six sizes, 7½ thru 800 hp — speeds up to 1800 rpm

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Cleaver-Brooks gives you—
ECONOMY
FROM EVERY ANGLE



Boilers . . . steam or hot water . . . for heating or processing, in sizes from 15 to 500 H.P., 15 to 250 PSI.

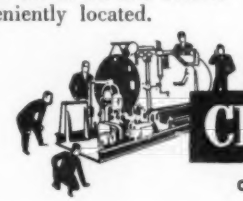
Use this guide to plan present and future boiler installations

Here are basic reasons why Cleaver-Brooks self-contained boilers SAVE money wherever installed. Remember these advantages when expanding your present plant or replacing obsolete boilers. For complete details, write for catalog AD-100, Cleaver-Brooks Co., Dept. J, 300 E. Keefe Avenue, Milwaukee 12, Wisconsin, U.S.A. — *Cable address: CLEBRO — Milwaukee — all codes.*

- **SAVES FUEL** — greatest efficiency and fuel economy through high-heat transfer of four-pass, forced draft boiler design.
- **SAVES SPACE** — boilers are compactly self-contained. Use less boiler room area. Fit into low headroom locations.
- **SAVES SERVICE** — factory assembled with trouble-free, quality components. Tested and backed by Cleaver-Brooks' one-source responsibility. ASME code constructed.
- **SAVES MAINTENANCE** — oil, gas or combination oil/gas firing eliminates bulky fuel handling. Designed for easy cleaning and inspection.
- **SAVES EXPENSE OF SPECIAL EQUIPMENT** — boilers available for hot water or steam service . . . heating or processing applications.
- **SAVES INSTALLATION COSTS** — no special foundation needed. Set boiler on existing concrete floor. Simple, roof-high vent eliminates costly smoke stack. Service connections conveniently located.
- **SAVES THRU FUEL FLEXIBILITY** — uses most economical and available fuel in your area. Exclusive burner permits 10-second gas/oil interchange.
- **SAVES BY QUICK STEAMING** — meets fluctuating steam loads automatically. Electronic controls start and stop burner. Safety controls assure 100% protection.
- **SAVES MANPOWER** — fully automatic operation. All controls easily accessible and all normal maintenance can be done by men without special training.
- **SAVES PLANNING TIME** — standard design in 15 to 500 hp; 15 to 250 psi gives you custom planning for single or multiple units.

IT PAYS TO PLAN FROM ALL *ANGLES* TO GET GREATEST BOILER ECONOMY — PLAN WITH CLEAVER-BROOKS — WRITE FOR DATA TODAY

"It's NEW — get the facts on the CB boiler — write today!"



Cleaver Brooks

ORIGINATORS OF THE SELF-CONTAINED BOILER

Con Edison specifies "K" Monel pump shafts for New Astoria Station

At their first all-new plant in 25 years, the Consolidated Edison Company means to take no chances with pump shaft trouble.

The Astoria Station, now under construction at the edge of New York's East River, has four single-stage vertical mixed flow pumps (each with a capacity of 68,500 gpm) to circulate water for its condensers. Made by Economy Pump Division of H. C. Wheeler Manufacturing Company, *all four pumps have "K" Monel shafts, as specified by Con Edison engineers.*

They singled out this rugged shafting material for several important reasons. For one thing, they knew "K" Monel offered them excellent resistance to corrosion. This was a basic need, for water drawn from the brackish, sewage-polluted East River is highly corrosive.

They wanted, too, a shaft metal that had great strength and hardness, and high resistance to corrosion fatigue.

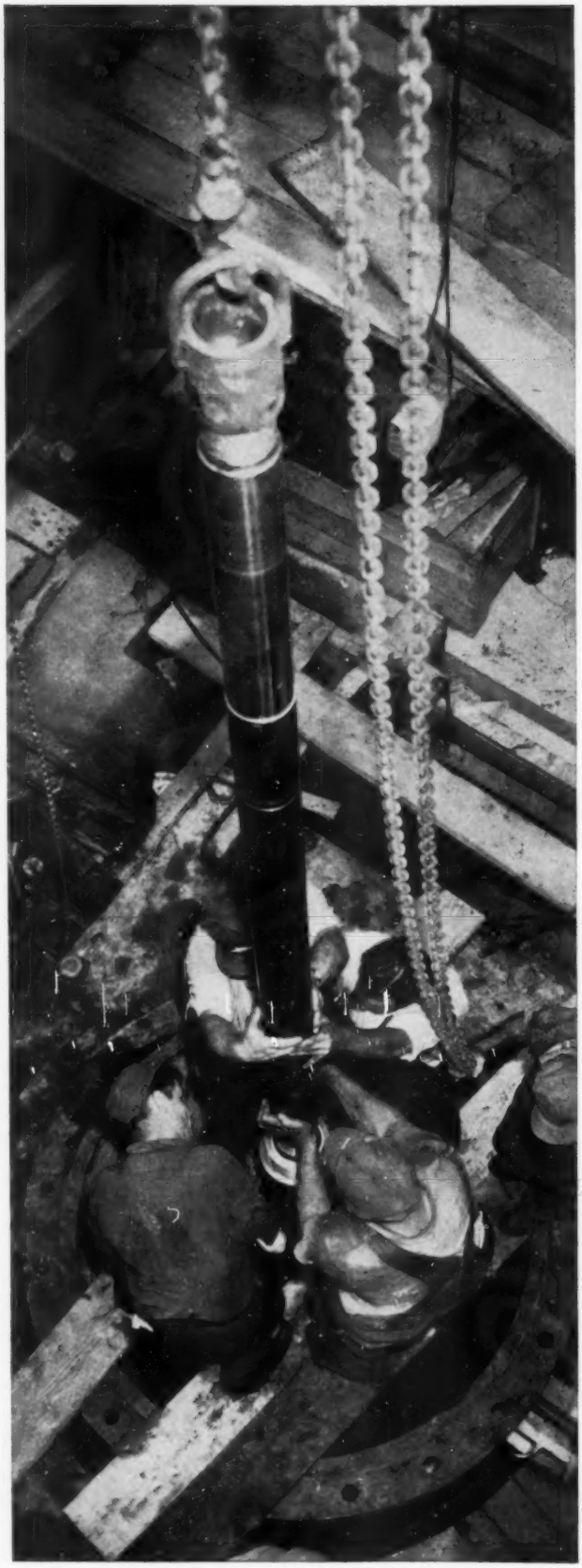
"K" Monel meets all these requirements. And it has the additional advantage of being heat-treatable *after* machining without undue distortion.

There's valuable information for pump users in our booklet, "*How to get longer service from your pumps.*" A copy belongs on the desk of every man concerned with the operation, maintenance or purchase of pumping equipment. The booklet will be sent promptly — without cost or obligation. Write for it — *today*.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Inco Nickel Alloys INCO

MONEL® • "R"® MONEL • "K"® MONEL "KR"® MONEL • "S"® MONEL • INCONEL® INCONEL "X"® • INCONEL "W"® • INCOLOY® NIMONIC® Alloys • NICKEL • LOW CARBON NICKEL DURANICKEL®



One of four. Workmen lower a "K" Monel shaft into a giant SAFV Wheeler-Economy pump at Con Edison's new station in Astoria, N. Y. This shaft is 6 inches in diameter, 27½ feet long, and weighs 1,900 pounds. It has a minimum Brinell hardness of 265. In operation, the pump, with a total dynamic head of 16 feet, will be driven at 233 rpm by a 400-hp motor.

When power demands GROW

...gain additional Kilowatts with...

Regulex
VOLTAGE REGULATORS

GENERATORS straining under the demand for ever-increasing kilowatt output take a new lease on life with the addition of *Regulex* voltage regulators. Automatic minimum excitation afforded by the *Regulex* voltage regulator allows the generator to operate close to the pull-out limit. Exceptional sensitivity and rapid response establish and maintain a safe ratio between generator load and field current. Operating limits at any given power factor are increased . . . best reactive kva division assured. It all adds up to maximum safe kilowatt output . . . more power to sell from your present generating equipment. For complete information call your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

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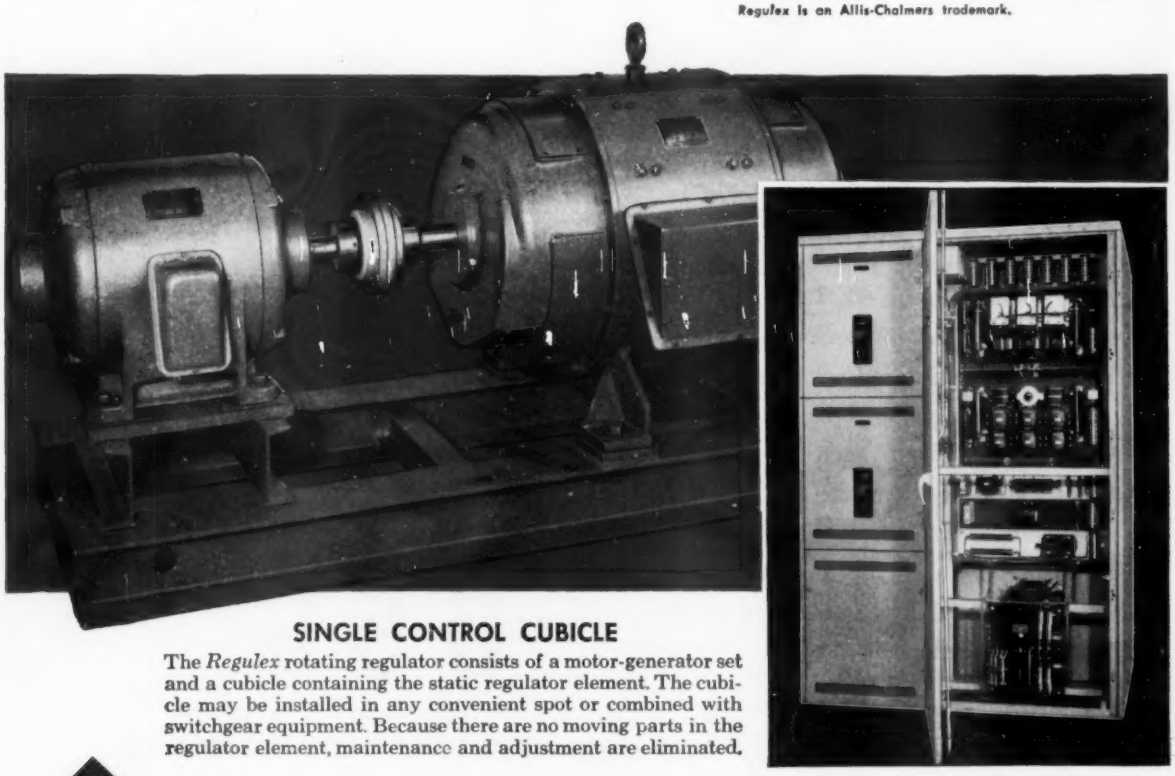
Regulex is an Allis-Chalmers trademark.



SINGLE CONTROL CUBICLE

The *Regulex* rotating regulator consists of a motor-generator set and a cubicle containing the static regulator element. The cubicle may be installed in any convenient spot or combined with switchgear equipment. Because there are no moving parts in the regulator element, maintenance and adjustment are eliminated.

ALLIS-CHALMERS

Immediate delivery from stock!

Three of the many types and sizes of USG Quality Gauges now carried in stock

When buying gauges ask for USG . . . where a most diversified stock awaits your selection. USG Gauges are stocked for your convenience. You can order any of a wide variety of instruments--233 types, dial sizes, and size ranges—without delay. Many of these gauges are obtainable immediately from the local stock of distributors of USG Gauges in principal cities throughout the United States. Or they may be ordered through your USG distributor directly from factory stock at Sellersville, Pa. Take advantage of this fast delivery service. Call the distributor of USG Gauges in your locality today for information on gauges. United States Gauge, Division of American Machine and Metals, Inc., Sellersville, Pa.

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Quality Gauges Engineered for Enduring Accuracy

PRODUCTS OF UNITED STATES GAUGE... Absolute Pressure Gauges • Aircraft Instruments • Air Volume Controls • Altitude Gauges • Boiler Gauges Chemical Gauges • Mercury, Gas, and Vapor Dial Thermometers • Glass Tube and Industrial Thermometers • Flow Meters • Inspectors' Test Gauges Precision Laboratory Test Gauges • Marine, Ship and Air-Brake Gauges • Voltmeters • Ammeters • Welding Gauges.

OTHER DIVISIONS OF AMERICAN MACHINE AND METALS, INC. AT SELLERSVILLE, PA.: GOTHAM INSTRUMENTS, AND AUTOBAR SYSTEMS

6 STAR FEATURES

WHO SAID THERE'S NOTHING NEW IN CENTRIFUGAL PUMPS

B & G SERIES 1510 TYPE B CENTRIFUGAL PUMP

Years ahead! A VERTICAL split case pump with balanced loading of impeller and bearings...capable of handling loads far in excess of those produced by any pump and motor combination! Easily serviced without breaking pipe connections!

1. **Solid-type Volute with Support Foot.** Can be left in pipe line when servicing pump—rugged construction absorbs piping strains.
2. **Removable Bearing Frame.** Complete bearing frame, including seal and impeller, can be removed without disturbing piping or motor leads. The bearing frame is replaceable and interchangeable on all sizes.
3. **Leak-proof Mechanical Seal.** Features the exclusive, harder-than-glass B&G "Remite" insert. This Seal Construction has enabled nearly two million B&G Pumps to make an amazing record for failure-proof performance.
4. **Hydraulically Balanced Impeller.** Balancing chamber and pressure relief holes in the impeller reduce thrust to a minimum, lengthening pump life.
5. **Anti-Friction Roller Bearings.** Timken Bearings handle thrust and radial loads for smoother, quieter, more efficient operation.
6. **Oil Lubrication.** No messy, undependable grease cups—circulating oil lubrication assures positive protection to bearings. Oil level indicator permits visual check.

SEND TODAY FOR SIZE AND CAPACITY DATA

BELL & GOSSETT COMPANY
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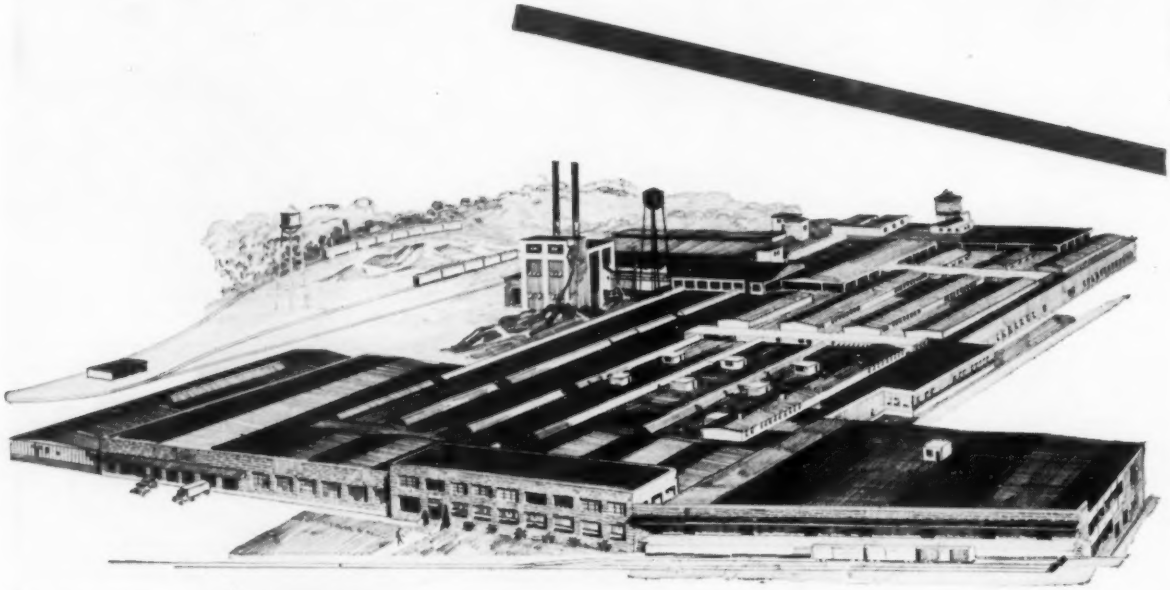
one WICKES

generates steam in new B. F. GOODRICH



At the Oaks, Pennsylvania, tire and tube plant of The B. F. Goodrich Company, part of a $9,000,000 expansion program now in progress includes modernization of the plant's power facilities. A new WICKES 2-Drum Steam Generator (shown in the blueprint) will help supply the steam necessary in the production of the 3,500,000 tires per year at this new plant. The unit will produce 115,000 lbs. of steam per hour at 300 lbs. pressure. It is equipped with an air heater and super heater. Like so many other industries and institutions that depend on steam for heat and power, B. F. Goodrich knows that WICKES Boilers are a reliable source of low-cost steam. WICKES will design and build water tube steam generators for any practical size and pressure. WICKES also offers a wide choice of auxiliary equipment so that you get not only the best steam generator, but also the best correlated equipment. Consult your nearest WICKES representative or write us today.

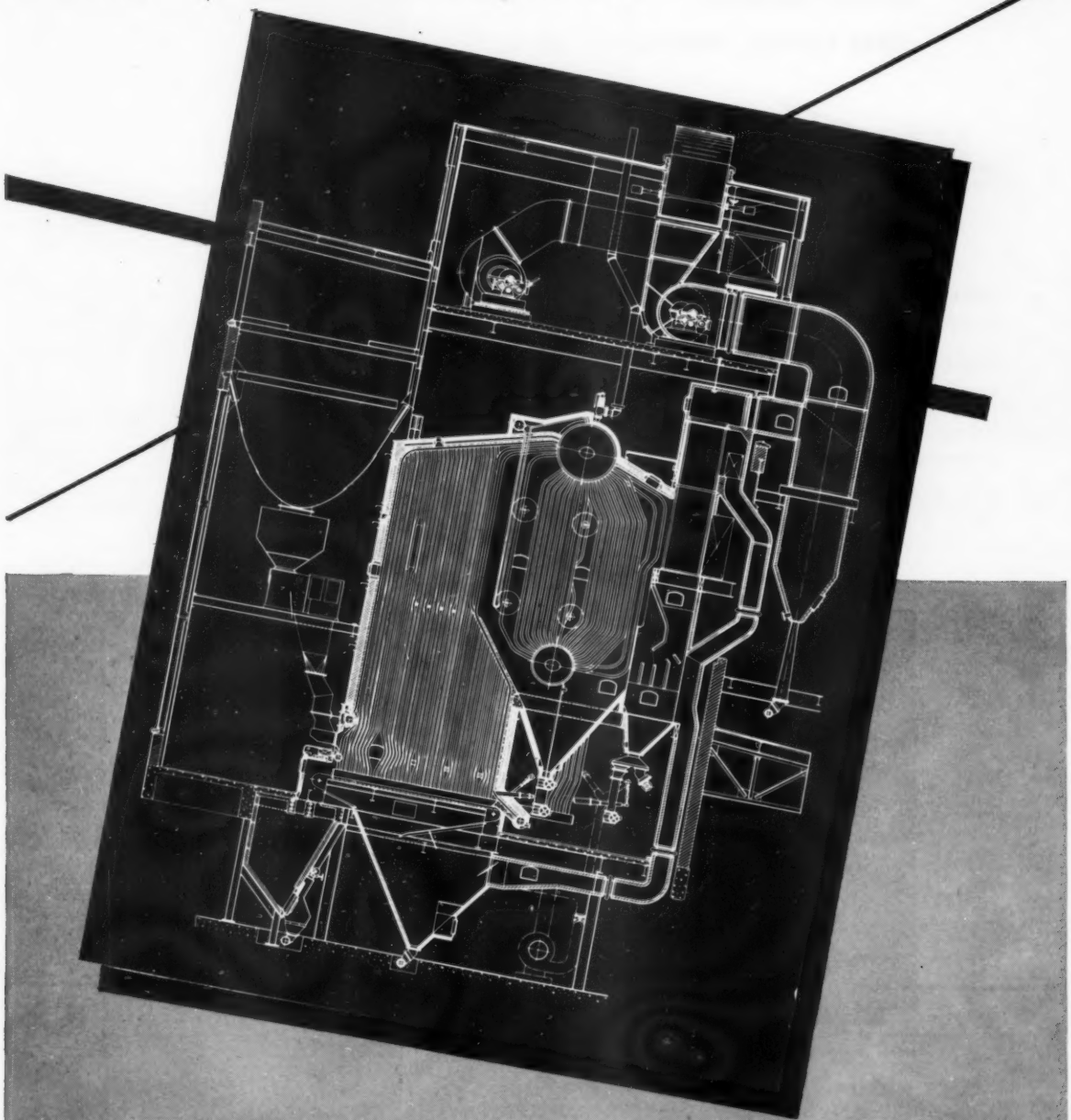
OUR 100th YEAR

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

two drum boiler

PLANT AT OAKS, PA.



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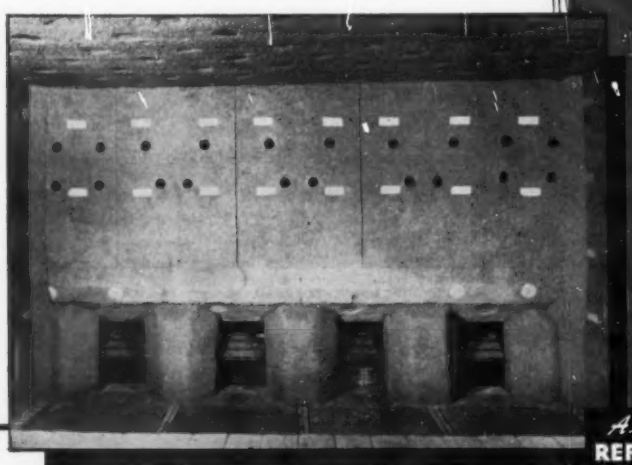
A. P. GREEN

PLASTIC FIREBRICK

GIVES LONGER, TROUBLE-FREE SERVICE

Look at these advantages

1. **Joint-Free Furnace Linings**
   present a solid monolithic front to slag and furnace gases.
2. **Elimination of Air Infiltration**
   lowers fuel cost and increases efficiency.
3. **Adaptable to Any Thickness or Contour**
   eliminating need for special refractory shapes.
4. **Freedom for Expansion and Contraction**
   with A. P. Green floating anchors.



View of monolithic Super-Plastic front wall showing stoker openings, stoker piers, and ignition arch.

WAREHOUSE STOCKS FOR PROMPT DELIVERY

Look in the Classified section of the telephone directory, or write direct for the name of the A. P. Green distributor in your locality. He has complete stocks and can make prompt delivery.

DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE WORLD

A. P. GREEN PLASTICS ARE "ZONE-RATED" TO DO THE JOB

4 TYPES TO MEET SPECIFIC REQUIREMENTS

GREEN-X

A super-duty graphite-type plastic refractory for monolithic linings of metallurgical furnaces and foundry ladles. Green-X is made of highest quality Missouri super-duty fire clay and contains a special binder that develops high strength. Resists the erosive action of molten metal and corrosion of slag.

SUPER HYBOND

Special super duty plastic that develops high strength throughout its entire thickness . . . regardless of furnace operating temperatures or total thickness of the lining. The back or cool portion against casing will form strong bond when enough heat has been applied to dry the plastic.

SUPER-PLASTIC

Super duty plastic made from finest Missouri flint fire clays . . . gives exceptional service . . . particularly in furnace sections most subjected to wear as a result of high temperatures, slagging, or load under soaking heat. Superior in resistance to high temperatures, spalling, slagging and excellent in load bearing strength.

PLASTIC QUIK-PAK

High duty plastic made from first quality Missouri fire clays. Excellent in resistance to spalling . . . high load bearing strength . . . low service shrinkage. Specify for complete monolithic furnace linings and patching material for quick repair . . . where furnace conditions do not require a super duty plastic.

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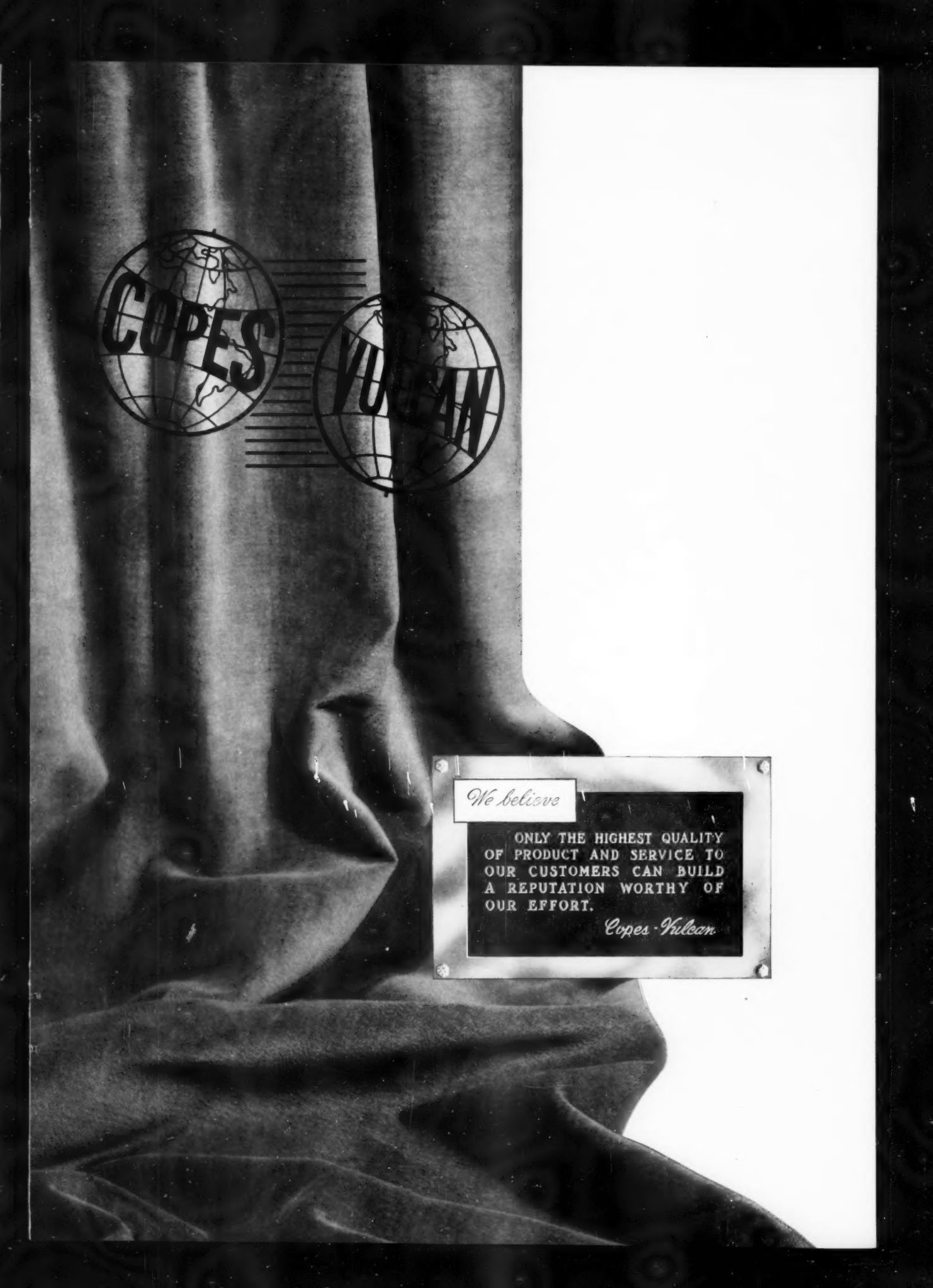
COPES
VULCAN
We believe
ONLY THE HIGHEST QUALITY OF PRODUCT AND SERVICE TO OUR CUSTOMERS CAN BUILD A REPUTATION WORTHY OF OUR EFFORT.
Copes-Vulcan

"So this is what makes

Yes . . . we do live up to the code you see so proudly displayed on our reception room wall and throughout our plant.

Each of us at Copes-Vulcan works hard to put just a bit of *extra* value into our equipment —its design—its construction—its application—its service.

We believe only the best will give you—our customer—the *most* for your money.

When you consider the service conditions our equipment must meet, the best is none too good for your installation.

YOU ARE IN OUR RECEPTION ROOM

COPES-VULCAN *tick"*

COPES VULCAN

COPES-VULCAN DIVISION

CONTINENTAL FOUNDRY & MACHINE COMPANY

CONTROLS AND MECHANICAL CLEANING FOR BOILERS

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COPES VULCAN

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Manufacturers of: COMBUSTION CONTROL . . . DESUPERHEATERS . . . FEED WATER REGULATORS . . . HI-LO WATER ALARMS . . . PRESSURE REDUCING VALVES . . . PUMP GOVERNORS . . . SOOT BLOWERS.

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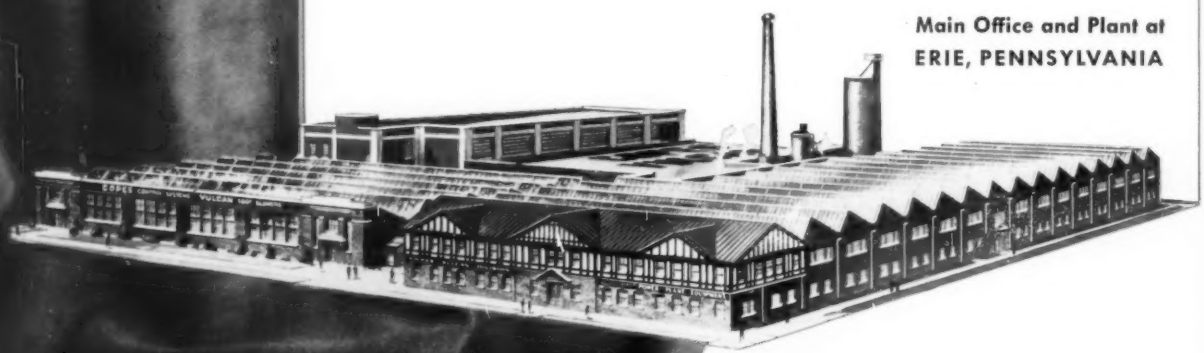
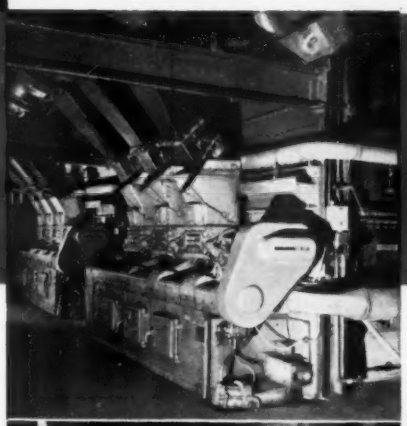
Main Office and Plant at ERIE, PENNSYLVANIA

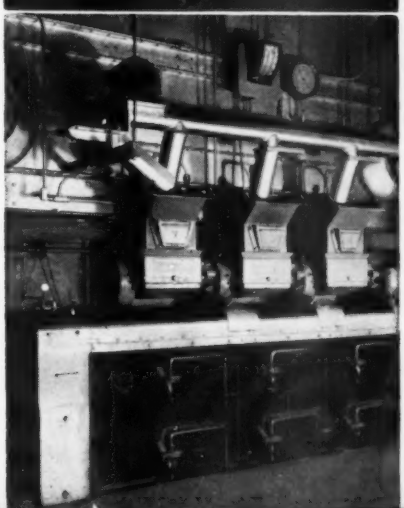


DETROIT ROTOSTOKER TYPE C-C *(continuous cleaning)*

Makes a Hit WITH ENGINEERS

They're buying Detroit RotoStokers Type C-C because of these exclusive features:





- Cleans Fuel Bed and Discharges Ash Continuously at the Front
- Smokeless Operation Through Wide Load Range
- Efficiently Burns Bituminous Coals and Lignite
- Insures Continuous uninterrupted Steaming Capacity and High Availability
- Responds Quickly to Fluctuating Loads
- Fuel Feeders Handle High Moisture Coals Easily and Without Clogging
- Operation Automatic and Dependable
- Easily Applied to Existing Boilers—No Basement required
- Design Results in Low Maintenance
- Sizes Available to Develop from Approximately 5,000 to 75,000 Pounds of Steam Per Hour

DETROIT ROTOSTOKER TYPE C-C

6879

Detroit RotoStoker Type C-C *(continuous cleaning)* installed or ordered for Steam Plants of:

Allied Chemical & Dye Corporation
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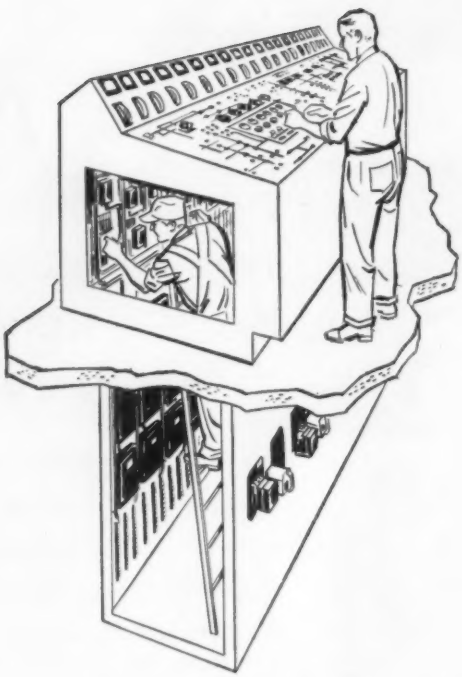
Jersey Central selects



MULTIPLE FUEL, CYCLONE FURNACE INSTRUMENTATION AND CONTROL BY HAYS, *for the new addition to Jersey Central Power and Light's Raritan River Plant, is mounted on this benchboard and auxiliary panels. The entire unit will be controlled from this centralized control station. The new steam generating unit has a maximum continuous steam output of 900,000 lbs/hr at 2050 psi and 1050 degs F with 1000 degs F reheat. It is of the pressurized furnace type with superheat and reheat steam.*

"2 story" benchboard to reduce costs

Why build a "2 story" benchboard? To consolidate over 300 switches, indicators, controllers, ammeters etc. in a minimum of space, yet provide easy accessibility for adjustment or removal for maintenance and . . .

1 **To reduce operating costs . . .** fewer men can operate more equipment.

2 **To reduce installation costs . . .** entire board fabricated at Hays . . . minimum field piping and wiring.

3 **To reduce maintenance costs . . .** indicators, controllers, etc. accessible from inside of panel.

purchased by **Jersey Central**
designed by **Burns & Roe, Inc.**
built by

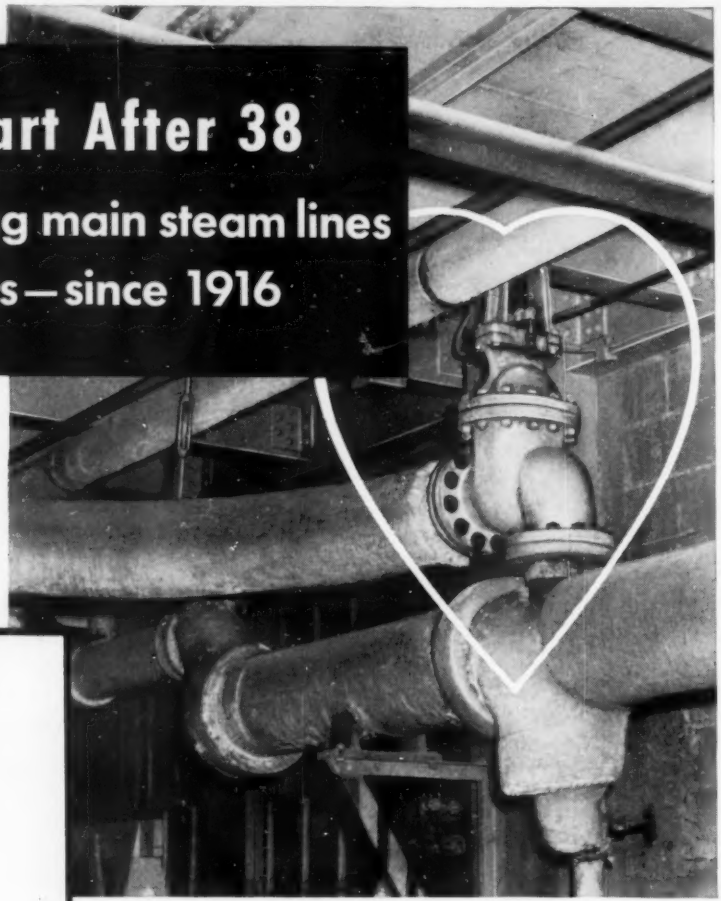
THE **hays** CORPORATION

MICHIGAN CITY, 3, INDIANA

Automatic Combustion Control • Veriflow Meters and Veritrol • Electronic Oxygen Recorders • CO_2 Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

Young at Heart After 38

Crane valves policing main steam lines with no repairs—since 1916



The Installation

In the Lehigh Portland Cement Co. plant at Oglesby, Ill. Original installation of 6- and 3-inch Crane steel valves in boiler-to-turbine steam piping. Working pressure: 160 pounds at about 475 deg. F.

Valve Service Ratings

SUITABILITY:
Hard to Beat

MAINTENANCE COST:
Not a penny for repairs

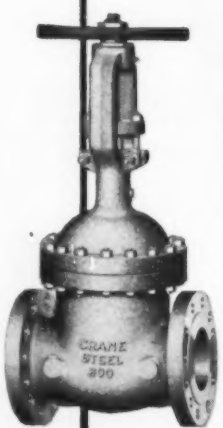
SERVICE LIFE:
38 yr.—still O. K.

OPERATING RESULTS:
Lowest cost steam control

AVAILABILITY:
Complete Crane line of modern patterns

The Valve

Like their 1916 counterpart designs, modern Crane Steel Valves give you performance that wins preference in every industry. They give you the values of steady leadership in steel casting . . . quality design . . . precise manufacturing. And the range of the Crane line in pressure classes, materials, and patterns, meets every need. See your No. 53 catalog, or your Crane Representative.



The Case History

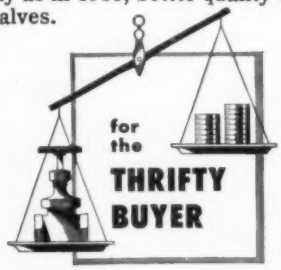
Never, since installed in 1916, have these Crane valves been out of service for repairs. Only care given—and good care, obviously—is prompt repacking of the stuffing box and lubrication when needed. Such attention usually includes a general clean-up.

Neither infrequent operation nor the non-lubricating properties of steam have troubled these valves. They respond to the handwheel with smooth, positive action. High wear-resistance in seating materials keeps them tight as new, year after year.

Buying quality valves from the start assured this amazingly low-cost main line steam control. Today this buying policy is more justifiable than ever. And today as in 1916, better quality valves mean Crane valves.

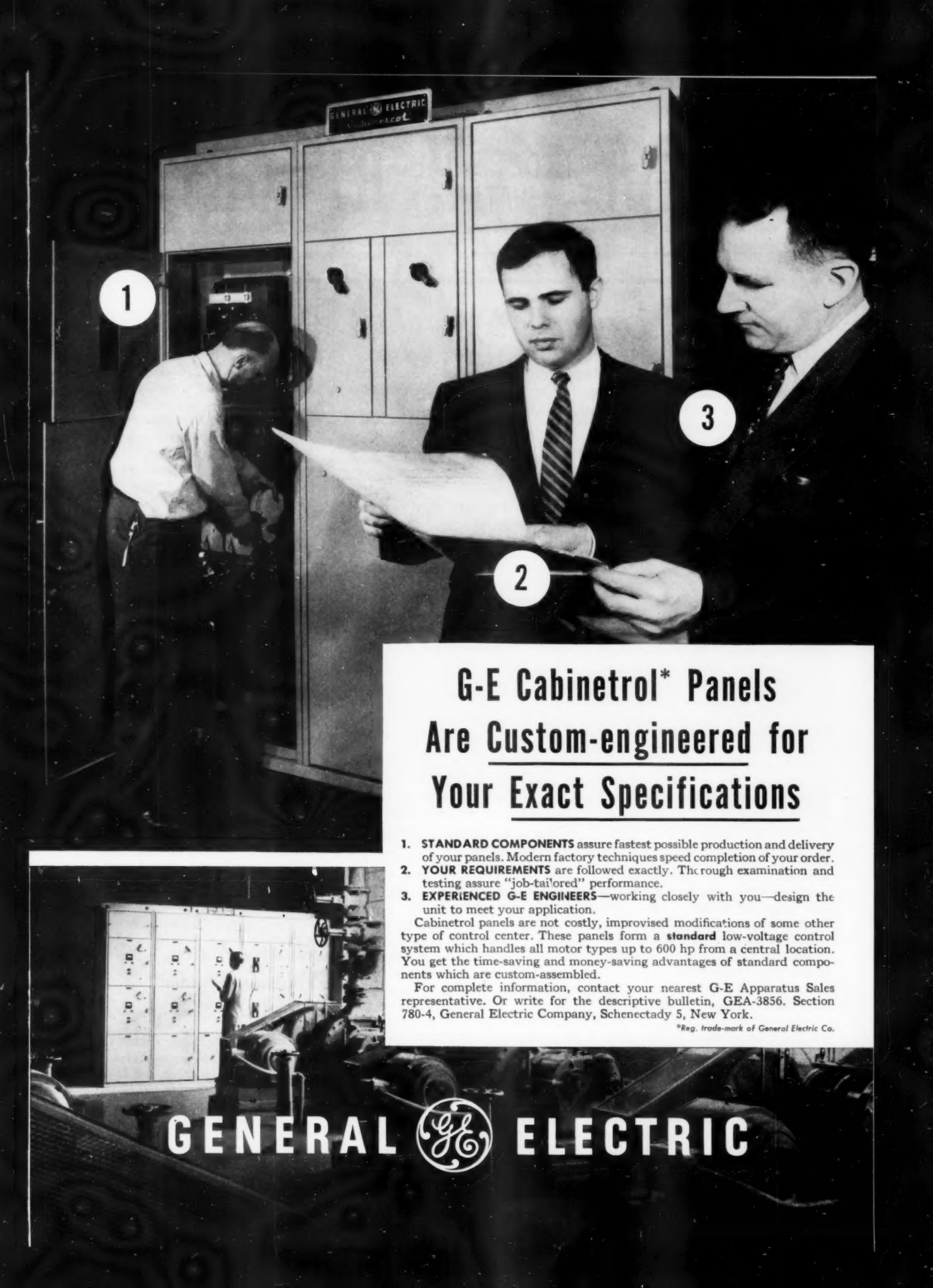
THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES



CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



G-E Cabinetrol* Panels Are Custom-engineered for Your Exact Specifications

1. **STANDARD COMPONENTS** assure fastest possible production and delivery of your panels. Modern factory techniques speed completion of your order.
2. **YOUR REQUIREMENTS** are followed exactly. Thorough examination and testing assure "job-tailored" performance.
3. **EXPERIENCED G-E ENGINEERS**—working closely with you—design the unit to meet your application.

Cabinetrol panels are not costly, improvised modifications of some other type of control center. These panels form a **standard** low-voltage control system which handles all motor types up to 600 hp from a central location. You get the time-saving and money-saving advantages of standard components which are custom-assembled.

For complete information, contact your nearest G-E Apparatus Sales representative. Or write for the descriptive bulletin, GEA-3856. Section 780-4, General Electric Company, Schenectady 5, New York.

*Reg. trade-mark of General Electric Co.

GENERAL ELECTRIC

(Advertisement)

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 2 AUGUST 1954 Number 4

Investigation from the Ground Up

A recent experience in a large utility plant took Hall Service engineer R. G. Hobek from the basement to the roof to investigate the connection between contaminated boiler water and a peculiar odor that was permeating the entire building.

The No. 2 unit of this plant is rated at 700,000 pounds per hour and is operated at 1500 pounds per square inch. Favorable operating conditions in the equipment at this power station are scrupulously maintained, so the plant men were disturbed when an unusual color showed up in water samples drawn from this boiler. At about the same time, a heavy odor became noticeable throughout the plant.

Mr. Hobek reports:

"We noted the heavy, sweet, organic odor as soon as we entered the building. When the boiler water was checked, it was found to contain a yellowish, well-dispersed material that would not settle, and could not be removed by ordinary filtration.

"We started our examination of the system at the condenser vacuum pump vent line in the basement where the odor was first noted. We followed the line to the roof where it exhausted. In observing the vent lines from the No. 1 and No. 2 units, we saw that the exhaust from the No. 1 unit rose directly to atmosphere while that from the No. 2 unit appeared to be heavier than air and seemed to flow down the outside of the vent line. We climbed to the roof and found that the odor of this heavy exhaust was the same as in the plant. An oily film coated the outside of the vent line.

"The ventilator intake for the plant is located about 50 feet from the vent lines. The fumes were being picked up here and carried throughout the plant.

"We suspected at this point that oil contamination would show up in the condensate and a sample was collected. Analysis of the sample confirmed our suspicion, and investigation by plant personnel showed that a broken weld on the turbine bearing oil return line had admitted from fifty to one hundred gallons of oil to the system."

Cleaning the oil from the system was a big job, but the early solution of the problem prevented real damage.

Waste Water Can Be Costly

Two recent civil suits could have been avoided by proper disposal of waste materials. The outlay for damages and court costs took these plants "off the hook" legally but did not solve their problems.

One plant dumped a water and molasses mixture into a ditch from which it seeped into a well supplying drinking water. The Supreme Court of the state upheld a substantial judgment against the plant, commenting ". . . one who by permitting pollution contaminates the underground water supply of his neighbor's well or sprir g, commits an act for which he may be required to respond in damages."

Another plant dumped water saturated with a mixture of dirt, chaik and chemicals into a stream. In sustaining an injunction against the continuance of this practice the Supreme Court of this state said, "The principle is that while water is on the land it belongs to the owner of the land, yet he cannot so use and adulterate it as to interfere with the enjoyment thereof by the next owner and if he does so, he is liable in damages for so using it."

Plant-wide Survey Pays Off

The cooling of precious metal bushings presented a critical problem for production and maintenance engineers in a fiber glass plant. Make-up to the open recirculating cooling system was untreated well water; the high "skin" temperatures encountered in the cooling system aggravated the corrosive and scale-forming properties of this water. Plugging of the restricted cooling channels, resulting in overheating of bushings, was a daily occurrence. Aside from production losses, damage to the bushings was often so extensive that recasting was not possible. New bushings cost several thousand dollars apiece.

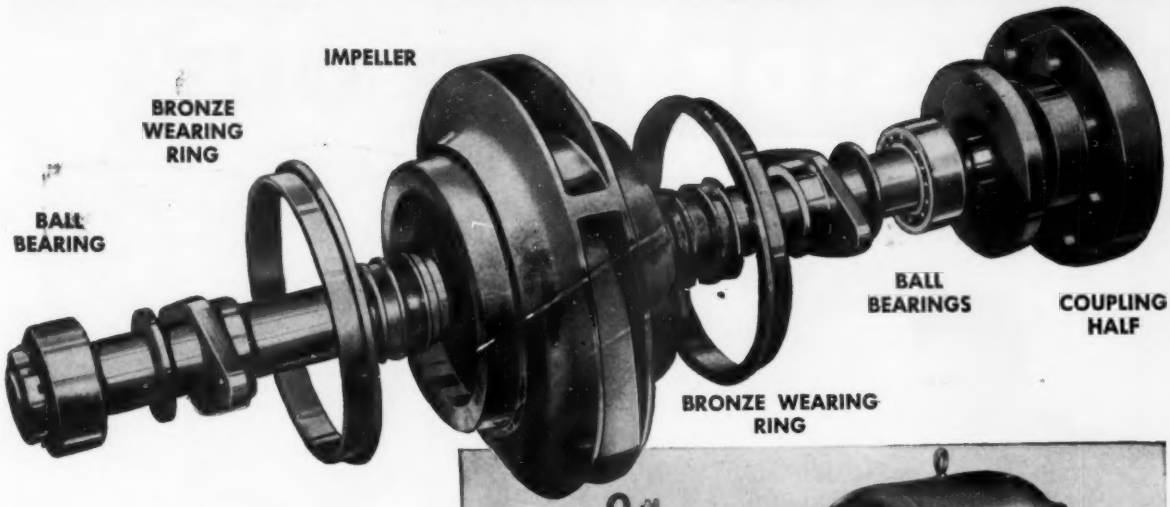
A plant-wide water survey by Hall engineer W. J. Reese showed the cooling problem to be sufficiently critical to justify split stream softening followed by treatment with a few ppm of glassy phosphate at a controlled pH. Since adopting this recommendation, the plant has operated continuously for two years without one instance of bushing failure resulting from overheating; this service record exceeds the calculated life expectancy of the precious metal bushings by many times. Probably the life expectancy of the Plant Engineer has also been materially improved.

Industrial Water Problems Require Special Handling

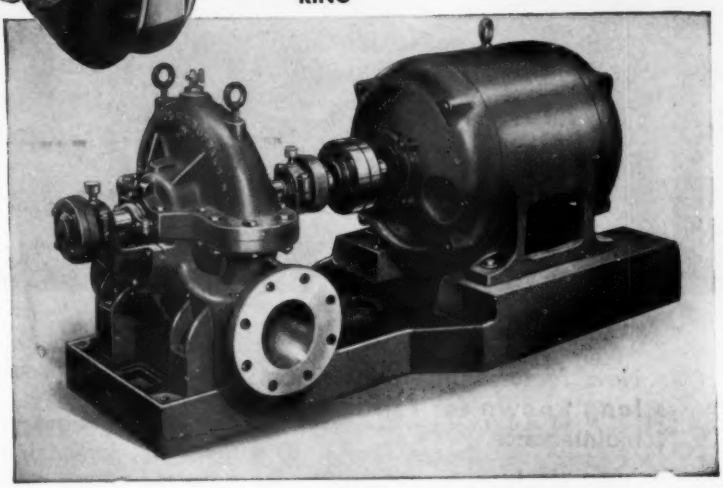
There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

INSIDE STORY OF A BETTER PUMPING VALUE



IMPELLER-AND-SHAFT ASSEMBLY OF A "BUFFALO" DOUBLE SUCTION PUMP



Take a look at the "heart" of a clear water pump that is built for performance and endurance! Note the oversize shaft and ample ball bearings to stand the severest continuous-service strains. The double suction enclosed impeller is hydraulically balanced and has vanes and shrouds shaped for maximum efficiency. The two large bronze wearing rings on either side of the impeller prevent leakage, thus keeping efficiency high.

And in the pump casing, water passages are simply formed with ample area to avoid friction losses and sudden changes of velocity. (Top half of casing is easily removable without disturbing piping, for quick servicing of impeller and stuffing boxes).

Here is a pump that cuts your costs where economy really counts—in continued high efficiency, in freedom from breakdowns, in easy maintenance and the kind of lifetime performance you need on your pumping job. Write for Bulletin 955-P and check construction data on these pumps in sizes from 10 to 14,000 gpm.

•

"Buffalo" PUMPS

BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, N.Y.

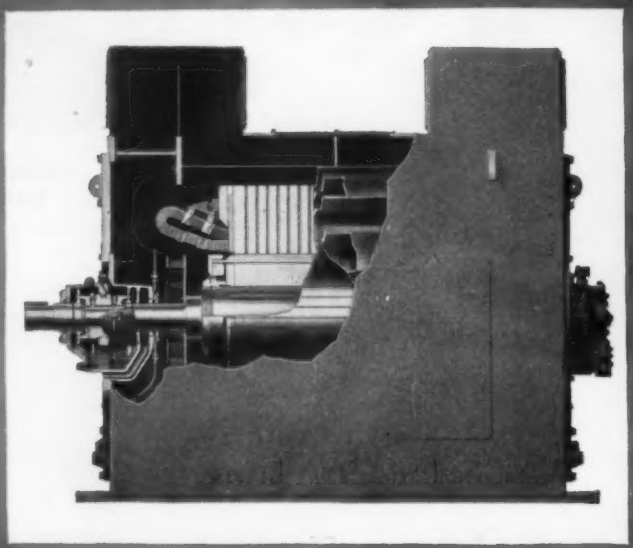
Subsidiary of Buffalo Forge Company

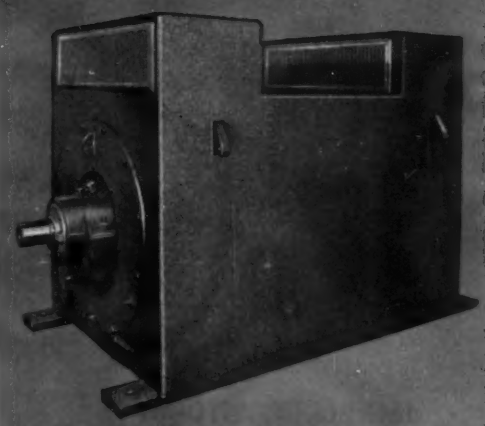
Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Redesigned

INSIDE AND OUT





ALLIS-CHALMERS
Boiler-Feed Pump
MOTORS

New features improve 2-pole motors long known for reliability and low maintenance.

New ventilating arrangement features top air intake and discharge *plus* spiral stator core ventilation. Top intakes (available with filters) keep motor clean and make motor room cleaning easy; top discharge adds to personnel comfort. Spiral ventilation — used in turbine generators — assures even internal cooling . . . combines with centrifugal fans and baffled air passages to reduce noise.

Improved bearing design simplifies maintenance, prevents oil leakage. Capsule-type housings — proved in use on other designs — permit inspection of windings without exposing bearings. Oil leakage is prevented by a combination of features, including orifice-metered oil flow, weirs to maintain correct oil level, labyrinth seals, breathers, and annular pressure chambers with atmospheric relief.

Clean-cut appearance is gained by providing internal space for stator and auxiliary leads, etc.

Features that helped build the Allis-Chalmers 2-pole motor reputation for reliability are retained in the new design. These include proven stator coil design, ample stator coil end bracing, thermally and mechanically stable cage assembly, separate balancing rings, and oxygen-free dew-drop cage bars.

This design available in ratings 900 hp and larger. Ask your A-C representative for Bulletin 05R8123. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4350

ALLIS-CHALMERS

Like to have a picture story of this petro-chemical plant?

Write for this booklet today!

Here's a brochure that's almost as good as a guided tour through the Tuscola, Illinois plant of National Petro-Chemicals Corporation. It's a picture story, in brochure form, of the design, construction and engineering of one of the world's largest petrochemical plants.

Twenty-four pages of photographs let you see for yourself the complexity of this $50,000,000 installation, for which J. F. Pritchard & Co. was the major contractor.

Your complimentary copy is waiting. Fill out and mail coupon today. No obligation.

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Please send me my complimentary copy of your brochure describing the National Petro-Chemicals Corporation's Tuscola, Ill. plant.

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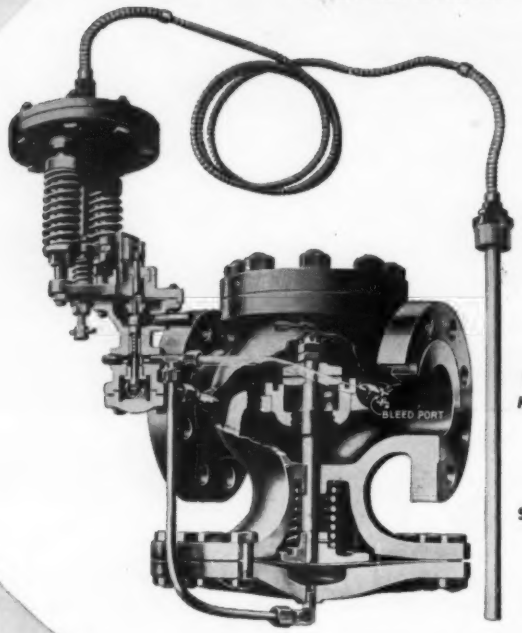
3 Reasons for Accurate Regulation

SPENCE TYPE ET150
TEMPERATURE REGULATOR



PACKLESS CONSTRUCTION

LARGE BALANCED METAL DIAPHRAGM

SENSITIVE PILOT

Spence

Packless construction eliminates the need for closely fitted parts that may stick or bind due to dirt or uneven expansion of the parts.

In Spence Temperature Regulators, the Main Valve is actuated by a large balanced metal diaphragm which responds to the slightest changes in temperature.

Sensitive Pilots are designed to limit heater pressure to an adjustable maximum. As the temperature at the thermostat drops a few degrees there is a corresponding increase in steam pressure up to the limit for which the Pilot is set.

With regulators that respond only to temperature, an increase in load is accompanied by a momentary decrease in steam pressure caused by faster condensation in the heating element. There is a time lag until the thermostat senses the temperature drop and opens the valve wider. Spence Temperature Regulators act like pilot operated pressure regulators when this occurs. They respond instantly to maintain the steam pressure until the thermostat has a chance to further increase it as needed for the heavier load.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year, without requiring extensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.

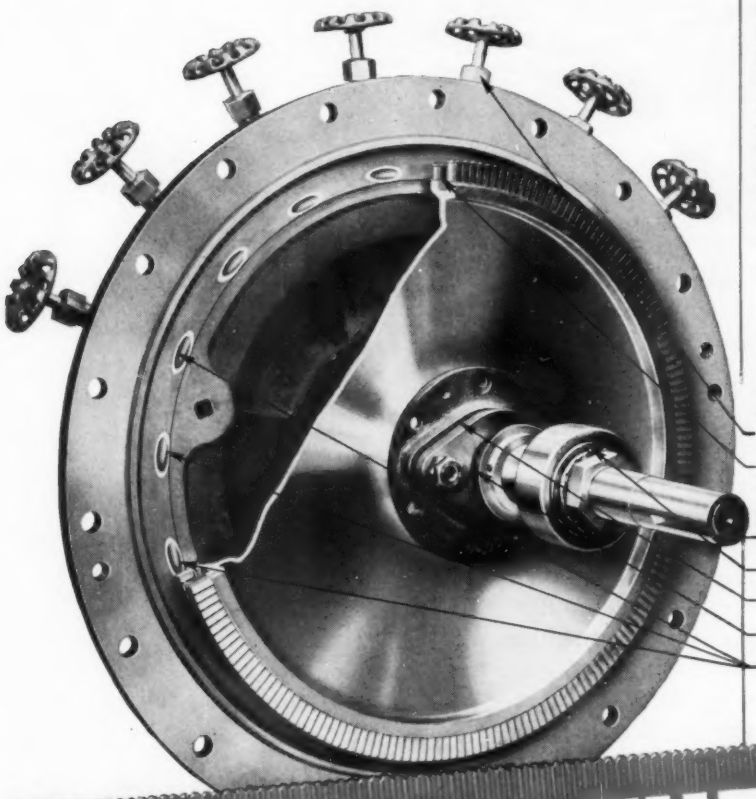
SE128

SPENCE ENGINEERING COMPANY, INC., Walden, New York

No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



7 hand valves for efficient partial load operation, (20" turbine shown)

2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced

30-40 carbon steel shaft

Oversized double row deep grooved ball bearing

Stuffing box with metallic packing ring

Heavy chrome plating of shaft through stuffing box

3 nozzles always open

Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

MAKE TURBINE DOLLARS GO FARTHER

Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP., 168 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

ERIE CITY VL STEAM GENERATOR

This one, fired by the Erie City Dumping Grate Spreader Stoker. Erie City VL's by the hundreds are serving a broad cross section of small to large steam users. These completely factory-assembled or field erected steam generators incorporate a 2-drum boiler and integral water cooled furnace for any mechanical firing method. We draw upon a 50 year experience with 2-drum boilers and a pioneering application of water wall design that keeps refractory maintenance to a minimum.

Only clean water can enter the integral water wall circulation. VL's are the most accessible boilers of this type—easy to keep clean and at top efficiency. Hospitals, Schools, Institutions, Dairies, Laundries, Industries and Process Plants use and repeat on VL's.

A FEW OF THE HUNDREDS OF ERIE CITY VL USERS

Cooper-Bessemer Corp.
Certain-teed Products Corp.
Dow Chemical Co. Bayer Company
General Chemical Co.
Pure Oil Company Liquid Carbonic Corp.
American Zinc Co. of Illinois
American Cyanamid Co.
Welch Grape Juice Co.

Get the COMPLETE STORY . . . **on this modern 2-DRUM Steam Generator for all mechanical firing methods.** *Ask for* **SB-43B**

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112 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

the Sky's the Limit

with SUPERIOR HEAT EXCHANGERS

Unlimited engineering facilities plus an adequate plant and equipment, make the sky the limit on Superior Combustion Industries' ability to design and fabricate heat exchangers for the most unusual conditions. Those shown here, designed for gas-to-gas heating, are 40 ft. high and 40" in diameter.

Our engineering staff invites your inquiry regarding any proposed installation . . . as a basis for a specific engineering recommendation.

For details of construction, write today for fully illustrated Catalog 6010.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR HEAT EXCHANGERS

By all indications **YOUR BEST BUY**

CLIMATE-PROOF CASE. Rain tight . . . snow tight . . . dust tight . . . sand tight . . . frost tight. The American Bi-Metal Thermometer can withstand submersion, hot blasts, dust, hot gases, extreme temperature changes and long exposure to the elements.

MAXIMUM RESPONSE — MINIMUM FLUTTER. Highly sensitive dampening fluid on bi-metal coil assures fastest response to temperature changes and greatest resistance to pointer flutter and destructive vibration.

ALL WELDED STEM CONSTRUCTION. Processing media cannot seep into case. Stem is stainless steel — corrosion-resistant — contributes to longer thermometer life.

Refineries, chemical and other processing plants find the American Bi-Metal Dial Thermometer "tops" for on-the-spot temperature readings.

Accurate

AMERICAN BI-METAL DIAL THERMOMETERS

Accuracy is guaranteed within 1% of the scale range. Application is simple and fast. Adequate clearance at back of case permits easy use of wrench during installation. Get complete information about these precision-built, long-life thermometers. Write for Bulletin 144.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is as close as your telephone. Take advantage of the broad experience of his organization and his ability to meet your most exacting requirements quickly from local stocks.

SPECIFICATIONS

Temperature Ranges: From minus 60° to 1000° F.

Dial Sizes: 3½" and 5". Graduations over full 270° arc.

Case: Aluminum alloy with smooth, black enamel instrument finish.

Bezel: Screwed to case.

Front: Heavy plate glass set in channeled gasket seals the case.

Pointers: Adjustable type attached with set screw; easy to get at for setting.

Connection: Fixed, ½" N.P.T.

Separable Sockets: Available for use in closed systems or where the measured medium is corrosive to the stainless steel stem. Fit over all standard stem lengths except 2½".

1850 AMERICAN U.S.A.

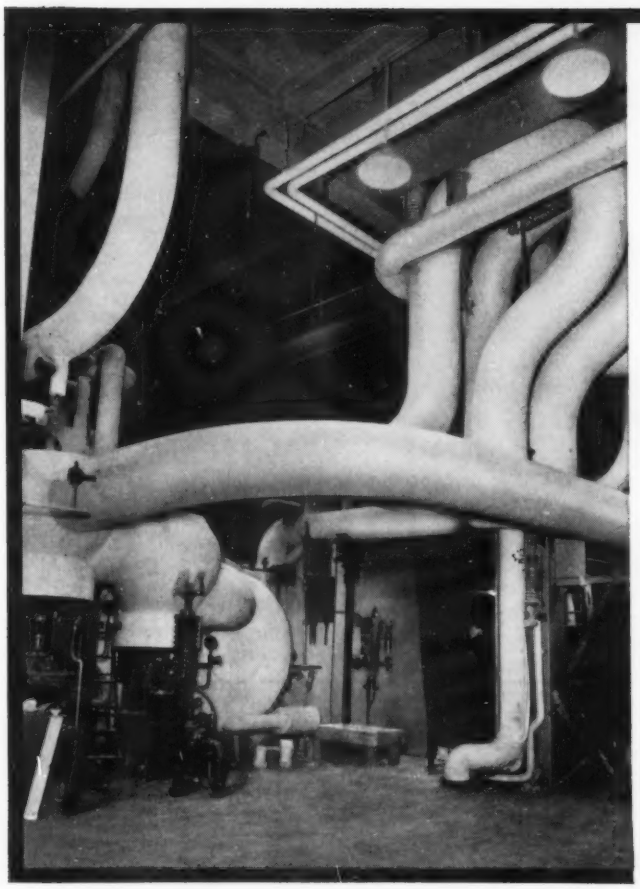
AMERICAN INDUSTRIAL INSTRUMENTS

MAXWELL MANNING MM&M MOORE INC. TRADE MARK

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

For safeguarding life and equipment Power Engineers prefer **NATIONAL SEAMLESS**



Today's power plant pressures of well over 1500 p.s.i., and temperatures of 1000°F. and more have necessitated material changes in power plant design. Of prime consideration, life and equipment must be safeguarded. Plant shutdowns due to premature tubing failure must be eliminated. And a system of pipe and tubes—free from potential areas of weakness—must be established. The one material invariably selected by designers to do the job is Seamless pipe and tubing.

USS NATIONAL Seamless Pipe and Tubes have never been surpassed for safe, efficient power plant service, even under the severest operating conditions. Pierced from solid billets of steel, NATIONAL Seamless Pipe and Tubes have all the strength, uniformity, and dependability of solid forgings. Each length is an homogeneous steel cylinder with uniform wall strength throughout, and is designed to remain structurally sound under high temperatures and tremendous pressures.

For further details on the use of NATIONAL Seamless in power installations, write for free Bulletins 10 and 26. Meantime, if you have the problem of planning a new installation, or repiping an old one, get in touch with us. Our engineers will be only too glad to give you the benefit of their experience.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS **NATIONAL Seamless PIPE AND TUBES**

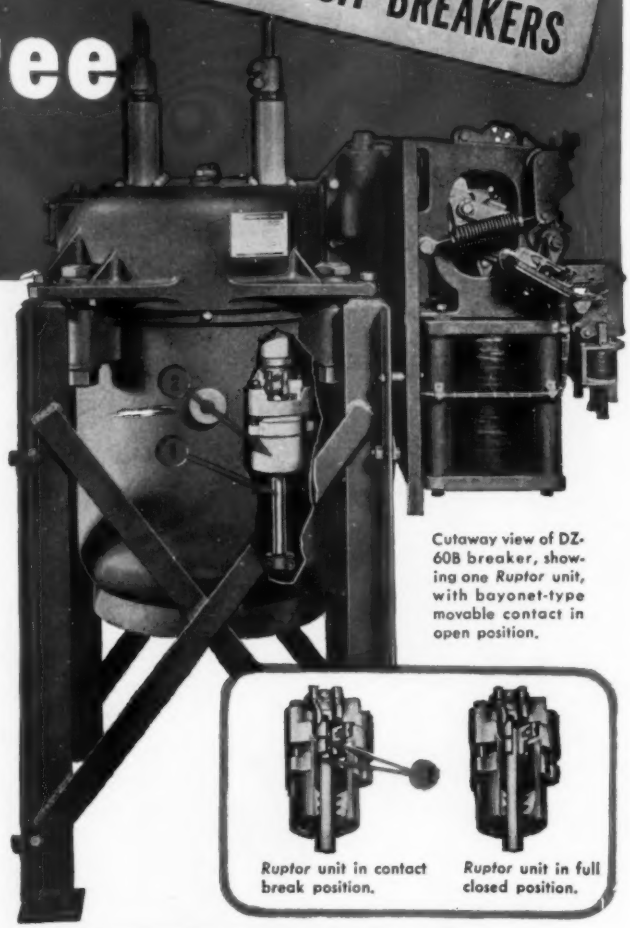
WALLS WITHOUT WELDS

UNITED STATES STEEL

Three Reasons Why

...Years of Trouble-Free Service

ALLIS-CHALMERS *Indoor* **OIL CIRCUIT BREAKERS**



Cutaway view of DZ-60B breaker, showing one *Ruptor* unit, with bayonet-type movable contact in open position.

Ruptor unit in contact break position.

Ruptor unit in full closed position.

One **Few moving parts!**

Bayonet contacts (1) are the only moving parts of the *Ruptor* interrupting device.

Two **Easy inspection!**

Drop the tank, and the bayonet contacts are visible in open position. For access to the stationary contacts, one needs only to remove four bolts and cylindrical shell (2).

Three **Self-aligning and Self-cleaning contacts!**

Tulip and bayonet contacts (3) maintain high conductivity without readjustment or cleaning. Arc energy is minimized by efficient interruption within oil-filled *Ruptor* unit. This in turn contributes to long contact life and low oil deterioration.

In addition, a mechanically trip-free solenoid operating mechanism controls contacts of time-proved *Ruptor* interrupting devices. And pole unit mechanism is self-lubricated — completely enclosed — sealed from dust, dirt, corrosion.

In brief, Allis-Chalmers DZ breakers are built to assure years of dependable, trouble-free service.

Allis-Chalmers power circuit breakers are available in ratings from 2.5 to 230 kv, with interrupting capacities from 15,000 to 10,000,000 kva, to meet all industrial and power company requirements. For more information, call your nearby A-C representative, or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4057

Ruptor is an Allis-Chalmers trademark.

TYPE	RATED KV	MINIMUM KV AT RATED KVA	RATED AMPS	KVA INT. CAPACITY
DZ-40B*	7.2	2.3	600	100,000
			1200	100,000
			2000	100,000
DZ-60B†	13.8	4.0	600	150,000
			1200	150,000
DZ-100B†	13.8	4.0	1200	250,000
DZ-200B†	13.8	6.6	1200	500,000
			2000	500,000

*Ask for Bulletin 71B6179. †Ask for Bulletin 71B6129.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Atom Power Comes Closer

TURN TO PAGE 83 to read why Francis J McCune of General Electric predicts competitive atom power within ten years. He says that by 1964 the electric utility industry will own and be operating a number of atomic power plants—and that these, *without government subsidies*, will be fully competitive with conventional power plants in U.S. areas of high fuel cost.

McCune gives cost estimates on the two types of reactors he considers the most likely candidates for early commercial use.

The first is the "boiling" reactor plant in which the steam to drive turbines comes directly from ordinary (light) water in contact with the fuel elements. This water, which boils by the heat of the nuclear reaction, serves also as the "moderator" to slow down neutrons and thereby make possible the atom-splitting chain reaction.

This corner-cutting type of design greatly reduces plant investment, eliminating costly heat exchangers and circulating pumps. With these are parallel operating savings: elimination of power to circulate the coolant and of the wasteful temperature drop associated with heat exchangers. Using ordinary water saves the cost of stocking the plant with heavy water at $80 a pound, and the corresponding operating waste associated with the leakage of this precious fluid.

McCune states unequivocally that GE can build such a 300,000-kw plant—including land, engineering, start-up costs and nuclear-fuel inventory—for $243 per kilowatt. The corresponding coal-fired plant figures $160.

Including fixed charges, fuel and other operating costs, the nuclear plant will produce a net kilowatt hour for 6.7 mills, he states. With high-cost coal at 35 cents per million Btu, power from the coal-fired plant will cost 6.9 mills. Thus, despite higher first cost, lower steam pressure and lower thermal efficiency, the more expensive nuclear plant shows a net advantage.

The offsetting factor is a 50% lower fuel cost per net kilowatt-hour—1.35 mills as against 3.4 mills for the coal plant. The nuclear-fuel cost estimate is based on uranium at $35 per pound, a "burn up" of 1% of its total mass and a plant thermal efficiency of 25%.

By a similar computation McCune estimates that a 700,000-kw watercooled reactor with graphite moderator will deliver power at 6.8 mills per net kw. He says that this also can be accomplished within ten years.

Because it avoids so many costly complications, the boiling type of reactor, using ordinary water, will appeal to the imaginations of practical power engineers. Also, it will raise some questions in their minds.

Particularly they will want to know whether steam coming directly from the reactor to the turbine will make the turbine so radioactive that it can't be maintained or repaired. Useful answers to such questions will be found in an article by Samuel Untermeyer (of Argonne National Laboratory), published in July *Nucleonics* (McGraw-Hill). Untermeyer shows why radioactivity will not seriously interfere with turbine upkeep in this type of plant.

It is now certain that many pioneer minds in power engineering—manufacturers, consulting engineers and operators—must grapple with nuclear developments in the years immediately ahead. It is none too early for all of us to learn what atom splitting is all about. That's why POWER last month started a series that will carry on for more than a year—the Nuclear-Energy Study Course by Schwenk and Shannon. Both are engineers of long experience in power work. Both had to dig out their nuclear knowledge the hard way. They tell a story that can be understood and applied by practical power men.

Now!...

An INTERRUPTING RATING in EXCESS of 100,000 AMPERES *for every set of fuse clips in your plant* . . . simply by installing FUSETRON *dual-element* FUSES

The Biggest Electrical Protection NEWS Since BUSS invented the FUSETRON Dual-Element FUSE

FUSETRON is a trademark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

In 1947 tests made by the Electrical Testing Laboratories of New York, showed that on a circuit set to deliver 50,000 amperes, FUSETRON fuses in all tests cleared the circuit safely.

50,000 amp. Interrupting Capacity in 1947
becomes
100,000 amp. Interrupting Capacity Today

After years of intensive development work on FUSETRON fuses new tests were conducted under conditions that simulated the most severe field conditions and these tests were witnessed and verified by the Electrical Testing Laboratories of New York.

On circuits set to deliver in excess of 100,000 amperes, 30 to 600 ampere, 250 and 600 volt FUSETRON dual-element Fuses on each and every test cleared the circuit without belching flame or venting hot gases and with comparatively little noise.

Oscillograms of these tests interpreted by the Electrical Testing Laboratories, showed that the total available amperes including the direct current component, reached values as great as 165,000 peak amperes on 240 volt tests and as high as 212,000 peak amperes on the 535 volt tests.

This indicates that an interrupting rating of 100,000 amperes for FUSETRON dual-element fuses is a conservative one.

No interference with time-lag

In the development work to increase interrupting capacity in FUSETRON fuses it was kept in mind that the time-current characteristic must be maintained. Time-lag is of utmost importance to give proper motor and electrical protection and to eliminate needless blowing of fuses.

Remarkable results have been achieved. Interrupting capacity has been greatly increased while the time-current characteristic of FUSETRON fuses has in no way been disturbed.

Play Safe - install Fusetron Fuses throughout the entire electrical system!

Think!...

ALL THIS ADDED SAFETY *without changing a panelboard or switch... plus* 10 Point Protection of FUSETRON *dual-element* FUSES!

Maximum Safety

With FUSETRON Fuses there is no cascading of interrupting rating — no places where an excessive fault current might cause serious damage. Every FUSETRON fuse has an interrupting rating in excess of 100,000 amperes.

You don't have to worry about selecting chosen spots in which to *pay extra* for "safe" equipment. Wherever a FUSETRON fuse is installed you have safety as sure and dependable as you can buy — no matter what you pay.

No Maintenance Costs

When FUSETRON fuses have once been installed properly you can forget about them. They need no periodic inspections to see if they will operate safely.

Dust, fumes, corrosion or age cannot prevent a FUSETRON fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

With FUSETRON fuses — you get safety — without one cent spent for inspection or maintenance costs.

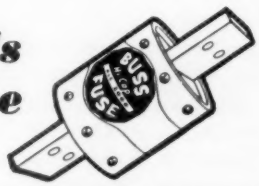
No Recalibration Costs

When a FUSETRON fuse does blow, there is no recalibration needed. As quickly as the fault in the circuit is corrected, you slip in a new fuse that has been CALIBRATED AT THE FACTORY BY ENGINEERS— a fuse that is as safe and dependable as the one that blew.

PLUS 10 POINT Protection with FUSETRON dual-element FUSES

1 Protect against short-circuits. **2** Protect against needless blows caused by harmless overloads. **3** Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation. **4** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5** Protect motors against burnout from overloading. **6** Protect motors against burnout due to single phasing. **7** Give DOUBLE burnout protection to large motors — without extra cost. **8** Make protection of small motors simple and inexpensive. **9** Protect against waste of space and money — permit use of proper size switches and panels. **10** Protect coils, transformers and solenoids against burnout.

for SAFE PROTECTION on loads above 600 and up to 5000 Ampere install BUSS Hi-Cap FUSES



Tests have shown that BUSS Hi-Cap fuses have unlimited interrupting capacity on circuits of 600 volts or less.

They are designed to give protection against dangerous overloads as well as high fault currents — yet their speed of operation on heavy shorts limits currents to safe values. This minimizes damage to equipment and cuts down dangerous stresses on transformers.

When coordinated properly with FUSETRON dual-element fuses they will not open ahead of the fuses nearest to the fault. Thus trouble is isolated to the part of the circuit in which the fault occurs.

Added SAFETY on Old Installations

On installations where the increase in the capacity of the circuit has outgrown the interrupting rating of the circuit breakers, BUSS Hi-Cap fuses offer a safe and relatively inexpensive way to protect inadequate breakers against rupture in event of a bad fault.

ACTION THAT SAVES YOU MONEY

By passing the word along that all purchase and stock records should call for FUSETRON fuses on loads up to 600 amps—and BUSS Hi-Cap fuses on loads above that — you get action that begets money saving.

For blowing time charts or more information on FUSETRON Fuses and BUSS Hi-Cap Fuses write for Bulletins FIS and HCS.

Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo. Division McGraw Electric Company

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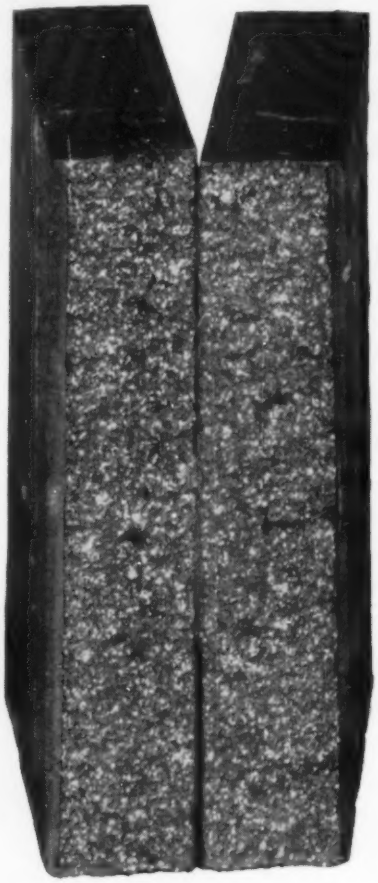

STEEL

These are actual photographs of fractured pieces of wrought iron and steel. The picture at the left shows the fibrous structure of wrought iron. How this differs from the crystalline structure of steel is readily apparent. It is the presence of many thousands of tiny threads of glass-like iron silicate that gives wrought iron this unique fibrous structure and it is this structural feature, duplicated in no other metal, that gives wrought iron its superior resistance to corrosion and fatigue stresses.

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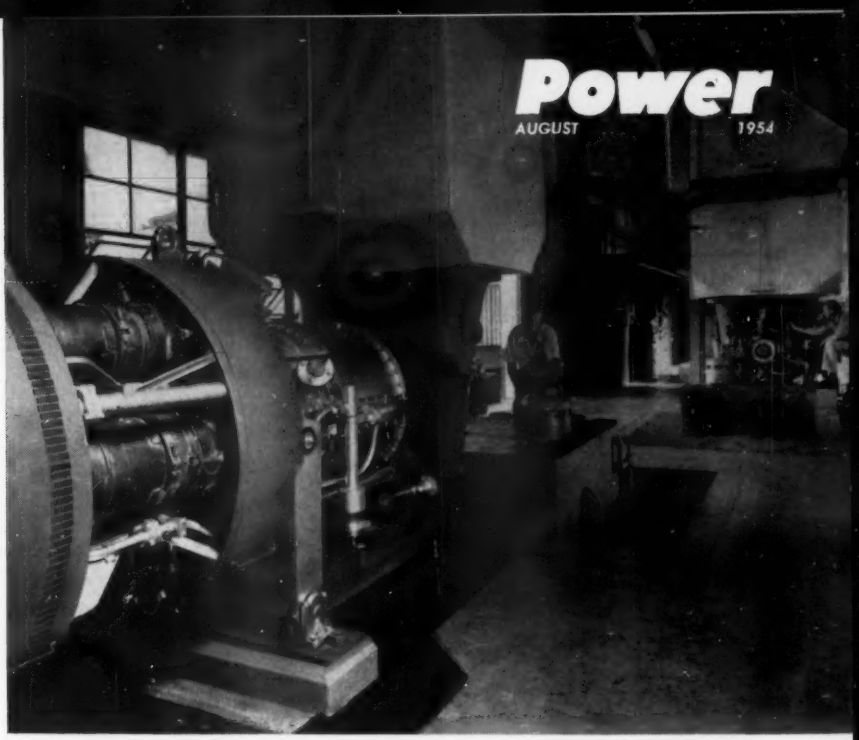
WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY STEEL PRODUCTS

Power
AUGUST 1954

By JOEL W BLAKE
Superintendent of Generation
Oklahoma Gas and Electric Company



NEW UNIT No. 4 stands at left; 30,000-hr veteran No. 3 stands at right in back

Belle Isle gas turbine: after 30,000 hours

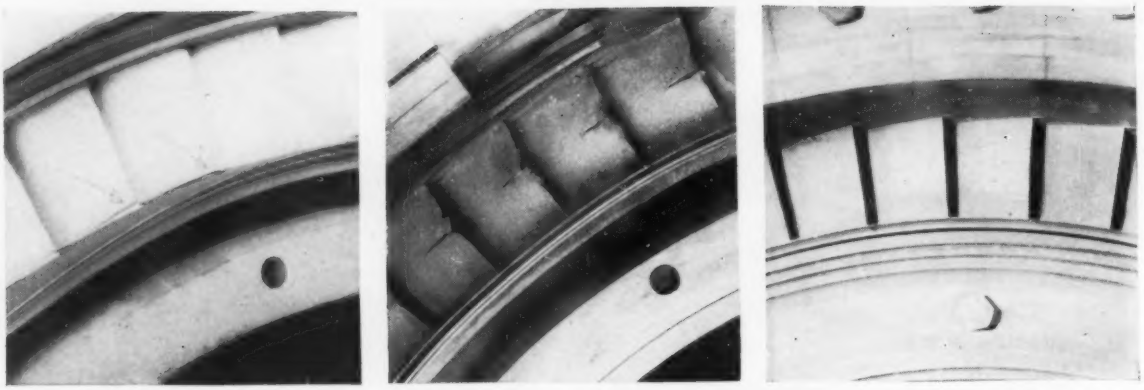
First commercial central-station gas turbine in U.S. chalks up topnotch operating and economy record. Here are details of findings made during the first major inspection and overhaul

► UNIT No. 3, a General Electric gas turbine, went into service in July 1949, at Belle Isle Station, Oklahoma City, Okla. It now has more operating hours than any other gas turbine in the world. Pioneer Service and Engineering Co designed this unit, the first to go into utility service in the U.S. The bibliography on p 184 refers to articles describing this installation in detail.

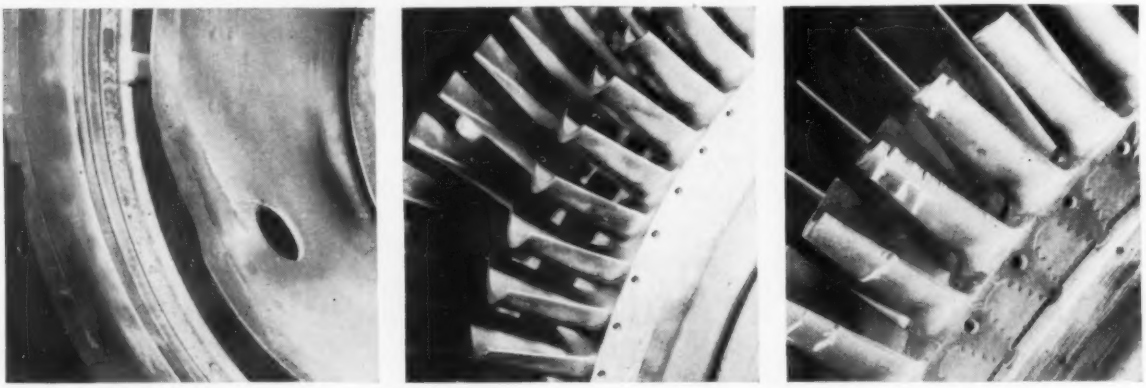
The simple-cycle unit burns natural gas and exhausts into heat-recovery equipment. The fuel burned generates 4500 to 5000 kw in this unit and through waste-heat recovery provides an additional 2500 kw from the 400-psi 750-F 2-in. backpressure steam end of the plant. Heat rate of the fuel fired in the gas turbine is about 13,000 Btu per kwhr, or 26% thermal efficiency.

Unit No. 4, of the same type and size as No. 3, went into service in 1952. Both these gas turbines with waste-heat recovery have raised the capability of the plant from its boiler limitation of 51 mw up to 66 mw, with a corresponding reduction in over-all plant heat rate of 2.5%. Both units were installed at a cost of slightly less than $100 per kw. The gas turbine is shown above, and plant heat balance in Fig. 6.

In making these installations we felt that if the gas turbine was to assume a preferred position as a utility prime mover, it should simulate steam turbines and boilers in reliability, maintenance requirements, and simplicity of operation. Promise of such characteristics appeared well founded, since with pure gas turbines there were no reciprocating motions and pulsating stresses as with other internal combustion engines. Absence of pistons and rings eliminated the lube-oil burning problem. Besides being an operating expense, this was a major factor in maintenance costs.



1 Turbine-inlet nozzle for first stage: *Left*, as found after 3900-hr operation in February 1950. *Center*, as found after 30,000-hr operation in September 1953. *Right*, after being repaired in current inspection, completed November 20, 1953



3 After 30,000-hr operation edges of the liner caps thinned and scalloped

4 First-stage buckets showed little change over 30,000-hr running period: *Right*, a few buckets were nicked by foreign material; *left*, condition after 2900 hr

With this background reasoning, we decided to handle the gas-turbine unit along the same maintenance pattern we were following for our steam-turbine units. Our practice has been, and still is, to inspect and overhaul all new steam-turbine units during their first operating year. Thereafter, they are scheduled for an inspection and overhaul every three years. We kept to this same schedule, without difficulty, with Unit No. 3.

Initial inspection and overhaul were made in the spring of 1950, after 3912 service hours, see bibliography item 5. Findings of this initial inspection were quite gratifying, since few defects were disclosed. However, since we had hoped to establish long-time maintenance predictions, we virtually made a "dry run" because of excellent conditions. We knew that, regardless of our findings, prime-mover perfection had not been achieved, and that some of the hot-zone components would require repair or replacement in time. We looked forward with much expectation to the second or 3-year inspection, which was made in the fall of 1953, after almost 30,000 hours of operation.

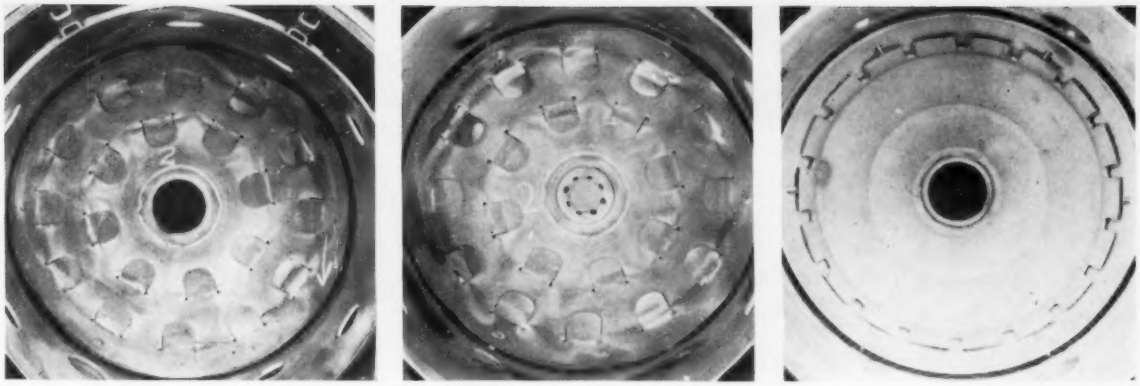
Three-year inspection. Since an inspection of this type generates maximum interest to the extent of adverse findings, we will accent these in the following report.

The unit was taken out of service on Sept 6, 1953 and returned on Nov 20, 1953. This is 76 calendar days, not at all impressive for overhauling a 5000-kw unit. Because of ample system capability, however, the work was carried out on an 8-hr day, 5-day week, with actually only 55 work days. Table I, p 79, gives an analysis of the outage time. Three items were responsible for the most time elapsed: (1) rotor bolt (2) first-stage nozzle (3) realignment of components.

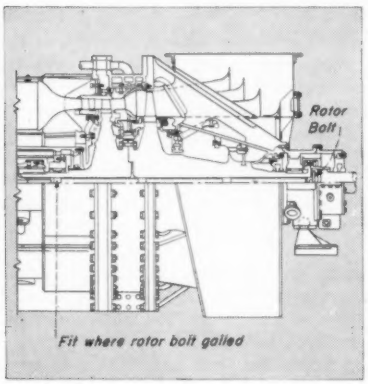
Rotor bolt, if of most modern design, should have come out with an elapsed time of about one hour. Because it was the original design, and the unit had not been out of service since design revision (about two years prior to teardown) we anticipated and encountered trouble. Fitted portion of the bolt had galled to the turbine rotor bore at the point shown in Fig. 5. It was necessary to return the rotor to the Dallas Service Shop to restore fits in the bore and to resize the journal, which had expanded oversize during bolt removal. A job, which on our new Unit No. 4 recently took only one hour, actually caused 41 outage days on No. 3. Since this rotor-bolt trouble was a design defect, it was reasonable that the manufacturer agreed to absorb incidental costs.

First-stage nozzle was the next long repair item. We expected the nozzle to have a short life. It should have shown some deterioration at the initial inspection, but it was in good condition at that time.

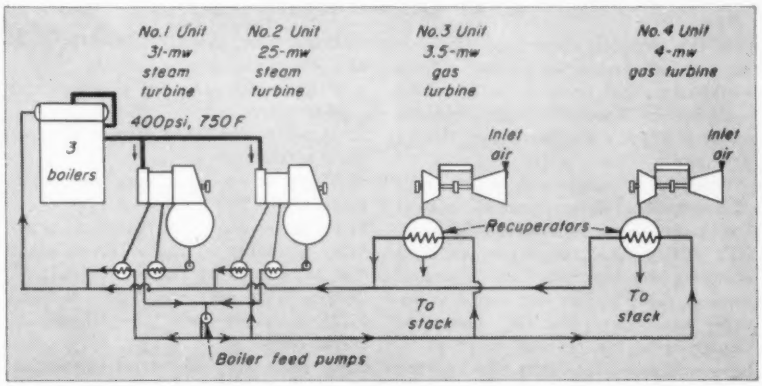
Since the nozzle and combustor liners receive the brunt of the 1400-F inlet temperature, we established periodic combustor inspections, requiring about 4 hr, to spot signs of deterioration. In these 2000-hr inspections we found that some cracking showed up and pro-



2 Combustor liner caps were subjected to highest temperatures. *Left*, No. 2 cap as found after 3900-hr run, February 1950. *Center*, same cap as found after 30,000-hr run, September 1953. *Right*, new heavier-designed replacement cap



5 Removing galled rotor bolt and resizing journal took 41 days to complete



6 Gas-turbine recuperators work in parallel with steam-turbine bleed heaters to heat boiler feedwater. Normally gas turbines run at appreciably high overload

gressed in the downstream portion of the first-stage nozzle partitions. Fig. 1 shows the nozzle conditions during initial and current inspections and after recent repair.

In discussing the situation with GE engineers, there appeared to be several ways to take care of the repair: (1) Replace entire nozzle at cost of $12,000. (2) Replace nozzle partitions at cost of $7200. (3) Weld nozzle partitions at cost of $1000 to $5000. Method 1, the most expensive, would require shortest outage time. Method 2 would take somewhat longer, and (3) the longest of all. We elected method 3, which required 24 days for shipping to factory and return, Table I. The repair cost $6000.

Partitions in this nozzle are 25-20 stainless and are not air cooled. Recent work by GE indicates that partitions made of other materials, with cooling, will have longer life. It is likely that when repairs are again needed, new partitions will be installed instead. The nozzle repair ran concurrently with rotor repair and did not add to downtime.

Alignment of unit was the third time-consuming portion of the work. For some reason (not exactly known) an almost complete realignment was needed. This included turbine-compressor unit, exciter, starting stepup gears, and starting motor. It was all done without regrouting but was time-consuming, accounting for 13 days elapsed time.

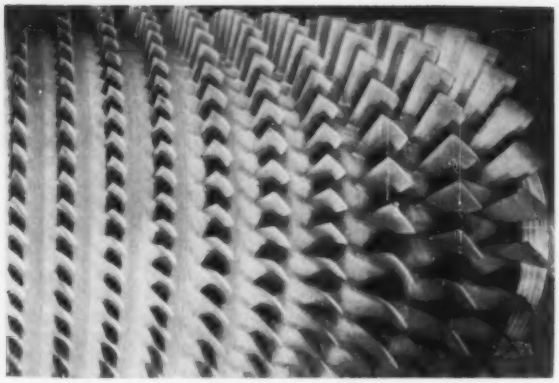
Combustors. During this inspection, all liner caps of the combustors were replaced. Fig. 2 shows cap condition at first and current inspection, and the improved heavier replacement design. Wasting away of the portion of the cap at largest diameter required the replacement. These parts had become paper thin and were becoming scalloped, Fig. 3. Otherwise, they were in good condition.

Turbine buckets. Both rows of turbine buckets showed little or no change during 30,000 hr operation. Fig. 4 compares original and first inspections. A few first-stage buckets show nicks from some foreign material, but no wasting away or erosion could be found. All bearings were in good condition.

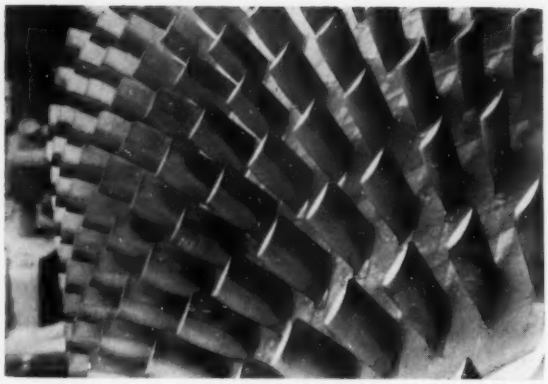
Compressor in general was in good condition. This unit has a fin-tube precooler and a window-screen mesh before its inlet. It has no air-washing or -filtering devices. The low-pressure portion of the compressor has to be cleaned about every six months to hold up the unit's load-carrying ability.

Some erosion was noted at tips of rotor blades and near root of stator blades adjacent to extraction zones in the compressor, Fig. 7. We believe that disturbance of flow pattern through the compressor by extracting a percentage of air along the staging caused this erosion. Neither the strength of the blades nor the efficiency of the compressor have been affected. In time, both may be affected.

It is felt that a wet-tower-type precooler, as on Unit No. 4, may remove sufficient dirt to prevent this action. Washing, however, can only be effec-



7 Compressor-rotor blades at low-pressure end, *right*, need to be cleaned every six months. How they looked Feb 1950



8 After 30,000-hr run compressor-rotor blades showed some erosion at tips near extraction zones in the compressor

tive with ambients above freezing. During original design we studied a filter installation, but decided to go along without one. Now we are again thinking about a filter, a viscous rather than a dry type.

Other unit components, which were of conventional design, were all in good condition. Minor refinements made by GE during this overhaul included changing the fuel regulator to one of modern design. The old one was entirely satisfactory but GE wanted to change it to use current spare parts. Certain built-in insulation blocks were replaced with modern types.

The turbine rotor was checked by several methods, including supersonic, and found to be sound and without defect. All other important parts of the unit were inspected by dyecheck or equivalent to indicate cracking in the stainless material. Some minor cracking was found in seals or diaphragms, particularly around the second-stage nozzle. Our own welders repaired all these on the job.

Waste-heat recovery equipment and duct work were in good condition. Some guide vanes in the exhaust ducts were cracked and required rewelding. All parts of the Combustion Engineering Corp recuperator were in excellent condition.

Maintenance costs. Unit No. 3 has now experienced sufficient operation to give some indication of maintenance costs for this type and size of simple-cycle gas turbine burning natural gas. Other factors may be encountered when burning oil. One of the most important factors, however, regardless of fuel is the temperature effects. Table II may well indicate what should be expected costwise from any gas turbine using a clean-burning fuel. A simple-cycle unit contains the same high-temperature components as does the complex unit and, therefore, should include the bulk of the high maintenance items.

Maintenance costs for this size and type unit are:

$2.05 per yr per kw of maximum capability (5000 kw)

$1.55 per yr per hp of maximum capability (6600 hp)

$1.37 per yr per kw of maximum capability including pickup on steam plant due to waste-heat recovery (5000 + 2500 = 7500 kw)

0.328 mills per kwhr gas-turbine-generator output

0.211 mills per kwhr total generation due to fuel fired in gas turbine

All these costs put the gas turbine in a very attractive position compared to steam prime movers and definitely ahead of any other internal-combustion type.

Keep in mind that this unit was one of two built as "firsts" in setting up a production-line-type unit. Many slight modifications were made in arriving at a final design. Hence, many of the minor replacement parts needed came as "specials" at a price from two to four times as much as similar parts for the production-line unit. This has been verified by comparing cost of parts for our No. 4 unit, which was installed in 1952, three years after No. 3. We hesitate to estimate what the correction should be, but a factor of less than 1.0 should be applied to correct these figures to present-day manufactured units.

The elaborate temperature detection setup furnished with No. 3 has an important bearing on the material costs. Since it was an "original" model the builder felt it necessary to record temperatures at numerous internal points in the turbine. These readings are of use to him, but are not necessary as a permanent procedure. Maintenance of these thermocouples has been expensive and accounts for 10% of the total material item. Only about one-half of the points now being maintained and recorded will be continued. In the future when any of these unneeded thermocouples go bad they will be abandoned.

As we mentioned, the unit was scheduled out every 2000 hr for inspection of combustors. Also, the present air-intake system causes fouling of the compressor and requires cleaning of the low-pressure section every six months. These operations account for a substantial part of the labor item during periods between overhauls.

Since the last overhaul, we have stopped periodic combustor inspections to follow the pattern used on our steam units—namely, to schedule annually a minor overhaul and inspection, with a major inspection and overhaul every three years. The manufacturer tells us that a compressor cleaning technique has been developed that will not require opening the compressor. These changes will materially cut down labor cost.

Operating data. Table III shows the unit's ability to sustain its capability and economy. It has been operated two ways. During the first 3½ years, system capability required loading Belle Isle to a fairly high load factor. With Mustang and Arbuckle Stations coming into operation, Belle Isle loading has dropped somewhat. During the first period, No. 3 gas turbine was in service 7 days a week, 24 hr a day with very few starts. The current period uses the unit 5 days a week, 16 hr a day, calling for one start per day, Table IV.

In both types of operation the unit has proven equally satisfactory. The ease and short time to start up make it ideal for peak service. Likewise, the small need for operator attention and the complement of quality control and supervisory equipment make it just as suitable for base-load service.

Throughout its life the unit has con-

Table I: — Sequence of 1953 inspection

Date	Description
Sept 6	Unit taken out of service for overhaul
Sept 7	Work started
Sept 9	Trouble encountered with rotor bolt
Sept 15	Rotor bolt removed
Sept 16	Turbine and compressor separated; first-stage nozzle removed for repairs
Sept 19	Field repairs to nozzle stopped, preparations to send nozzle to Schenectady, N. Y.
Sept 22	Turbine rotor shipped to Dallas Service Shop for repair of damages resulting from stuck rotor bolt
Oct 14	First-stage nozzle back from factory
Oct 23	Finished assembling and fitting nozzle
Oct 26	Turbine rotor back from Service Shop
Nov 4	Turbine-compressor unit assembled on moving skid
Nov 6	Realignment of unit started
Nov 19	Realignment completed
Nov 20	Unit back in service

Table II:-Summary of maintenance costs

Operation	Period	Operating hours	Maintenance costs: Labor	Local material	GE Co material	Total
Maintenance	7/29/49 to 2/2/50	3,912	$1515	$999	$14	$2,528
Overhaul	2/2/50 to 3/22/50	0	5064	114	1867	7,045
Maintenance	3/22/50 to 9/6/53	26,046	7299	455	3914	11,668
Overhaul	9/6/53 to 11/20/53	0	6622	255	16,312	23,189
Total	7/29/49 to 11/20/53	29,958	$20,500	$1823	$22,107*	$44,430

Breakdown of General Electric Co material:

1. Time and expense of GE engineers	$ 6,006
2. Thermocouples and connectors	2,080
3. Repairs to first-stage nozzle	5,990
4. Combustor liner caps, 6	1,552
5. Repairs to fuel regulator	523
6. Improved compressor 1st-row stator blades (not strictly maintenance item)	2,127
7. Miscellaneous: rectifiers, O rings, flame detectors, bolts, nuts, etc	3,829
Total	$22,107

Table III: Operating data for No. 3 gas turbine

	7/29/49 to 2/6/50	2/6/50 to 9/6/53	7/29/49 to 11/20/53
1. Total installed hours	4,604	31,407	37,801
2. Total operating hours	3,912	26,046	29,958
3. Total nonoperating hours	692	5,361	7,843
4. Total scheduled inspection and maintenance hours	658	3,064	5,512
5. Total forced outage hours	34	360	394
6. Total available but not operated hours	0	1,937	1,937
7. Average heat rate, Btu per kwhr	20,604	19,843	19,933
8. Nameplate capability, kw	3,500	3,500	3,500
9. Average load, kw	3,959	4,613	4,527
10. Average load, % of rating	113	132	129
11. Total maintenance cost	—	—	$44,432
12. Total output, mwhr	15,486	120,147	135,633
13. Unit maintenance cost, mills per kwhr	—	—	0.328
14. Unit maintenance cost, $ per yr per kw*	—	—	2.05
15. Average inlet air temp, F	56.7	62.8	61.9
16. Average exhaust temp, F	776	821	815
17. Average turbine-inlet temp, F	1310	1375	1366

*Based on 5000-kw capability

Table IV: Number of starts for No. 3 unit

	1949	1950	1951	1952	1953
January	—	8	3	0	29
February	—	1	7	2	21
March	—	5	1	2	12
April	—	1b	4	2	22
May	—	3	0	1	19
June	—	1	2	1	10
July	1	3	1	4	5
August	27	1	1	2	4
September	12	3	1	3	—
October	6	3	2c	2	—
November	10	0	2	5	—
December	4a	1	0	30	—
Total	60	30	24	54	122

Total to September 1953 = 290

Number of starts at time of first overhaul = 69

aExhaust temperature raised from 780 to 830 F
bExhaust temperature raised from 830 to 850 F
cExhaust temperature raised from 850 to 860 F

sumed only 420 gal of lube oil. This gives an astounding ratio of 470,769 hphr per gal. Production cost for lube oil at 75c per gal is 0.0023 mills per kwhr.

Economy of the unit continues to be better than guaranteed. As far as we are concerned, the unit heat rate is checked only as a component of the complete installation, much the same as boiler efficiency is checked in a steam plant. Heat rate of the combination is our real interest.

Table III also shows the reliability of the unit. Only three forced outages occurred, and all scheduled outages could have been postponed indefinitely.

We believe this record, including peak-load operation, speaks well for dependability of the unit.

The forced outages were:

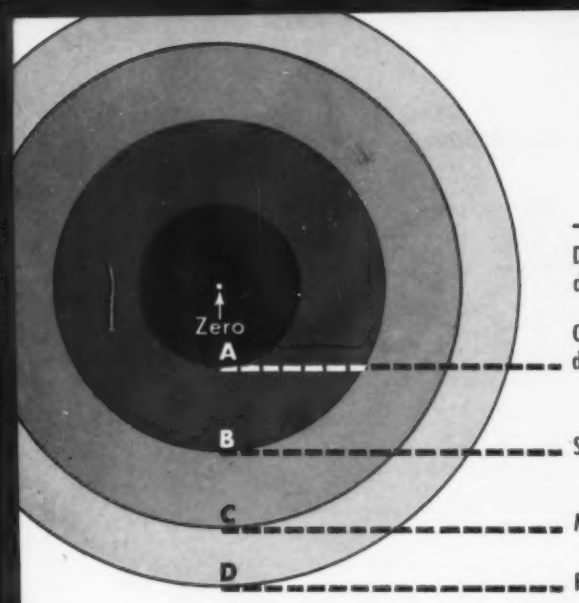
1. Failure of main lube-oil pump impeller ..... 30 hr
2. Flame-detector amplifier trouble 4
3. Failure of exciter armature ..360

Total .....394 hr

Conclusion. This report of the inspection, after 30,000 hr operation, should benefit the industry in appraising what long-time maintenance costs should be. The manufacturer had very extensive experience in building gas turbines for aircraft before making No. 3 unit. The impulse turbines with only two stages favor the rotating members as to temperatures. Taking the "curse" off the inlet temperature by the first-stage nozzle, a stationary part, is felt to be a definite influence for the excellent condition of the turbine buckets. True, the first-stage nozzle needed repairs, but had it not been a static component, we believe this whole report would have been much different. Remarkable life of the combustor liners indicates what can be done by using the "can type." Multiple combustors appear to favor temperature equalization in much the same manner currently followed with high-temperature steam turbines.

This application, with over four years of service, has proved the feasibility and economy of combined gas-turbine steam-turbine operation. Deficient boiler capability, through waste-heat recovery,

(*Continued on page* 184)



Degree of damage	Relative radii and areas: Radius or dia.	Circle area	Ring area	Estimate of destruction: Value units in ring	Percent destroyed	Value units destroyed
Complete destruction	1	1	1	100	100	100
Severe	2	4	3	300	50	150
Moderate	3.2	10	6	600	25	150
Partial	4	16	6	600	10	60
						total 460

360 units

Outer areas are more important

While popular imagination centers on the inner zones where bomb has maximum effects, the fact remains that the far larger outer areas of less severe damage are much more important from the angle of total casualties and total property damage.

For any bomb, take the radius (from ground zero) of complete destruction as unity, *1, above*. Then the radius of severe damage (by shock wave) will be *2*, radius of moderate damage *3.2* and of partial damage *4*, corresponding to the four circles *A, B, C* and *D* in the diagram above. *These ratios hold for all sizes of bombs from the smallest A bomb to the largest H bomb.*

Remembering that area increases as the square of the radius, and that any ring is the difference between two concentric circles, we see that the relative areas of rings *A, B, C* and *D* are 1, 3, 6, 6.

If we assume a uniform distribution of population and property over the bomb pattern, and the indicated percentages of destruction in each ring, we see that nearly 80% of all lives lost, and of all property destruction, is outside the central zone of complete destruction.

After making all allowances for the actual, very irregular, patterns of population and property, it is clear that shelters of moderate strength and cost, plus other common-sense protective measures, will probably save more lives in the outer areas than the total lost in the central inferno. This conclusion holds true for the largest H bomb and shows the irrationality of the popular fatalistic attitude.

Bomb-blast table and charts

By **PHILIP W SWAIN**
Editor of Power

► RECENT POPULAR DISCUSSIONS of H bombs of unprecedented power have loosed a confusing torrent of "bomb rhetoric." Colorful journalistic adjectives have created excitement and apprehension without conveying the cool understanding that is so urgently needed in matters of this sort.

It would seem that engineers, along with scientists and military experts, are about the only Americans who habitually view physical phenomena in quantitative terms. It is important that they, in particular, understand the destructive effects of nuclear bombs in terms of distance and area, as related to the energy of the bomb.

For that reason I have computed table and charts primarily as a guide to my fellow engineers, for they will have many opportunities to point out that the H bomb, great as it is, is not infinite. However big the bomb, its destructive effects can always be stated in everyday terms.

Table on facing page gives the radius and area of destruction for various degrees of blast damage from the shock wave of an A bomb or H bomb set off high in the air (presumably several thousand feet for the larger bombs). Distances are measured from "ground zero," the point on the ground directly underneath the bomb.

This table covers the extreme range from the original 20,000-ton (TNT equivalent) A bomb to H bombs larger than any yet tested. In the column headings, bomb energies are abbreviated by the use of "kiloton" to mean 1000-ton TNT equivalent, and "megaton" to mean 1,000,000-ton TNT equivalent.

I have computed these tables from data and blast scaling law given in the official book, *The Effect of Atomic Weapons*, prepared for the U.S. Depart-

Bomb Energy (TNT equivalent)		Radius of damage, miles				Area of damage, square miles			
Kilotons	Megatons	Complete	Severe	Moderate	Partial	Complete	Severe	Moderate	Partial
20		.5	1.0	1.6	2.0	.8	3.2	8.0	12.6
40		.6	1.2	2.0	2.5	1.1	4.5	12.6	19.6
60		.7	1.4	2.3	2.9	1.5	6.2	16.6	26.4
80		.8	1.6	2.5	3.2	2.0	8.0	19.6	32.2
100		.9	1.7	2.7	3.4	2.5	9.1	22.9	36.3
200		1.1	2.2	3.4	4.3	3.8	15.2	36.3	58
300		1.2	2.5	3.9	4.9	4.5	19.6	47.8	75
400		1.3	2.7	4.3	5.3	5.3	22.9	58	88
500		1.4	2.9	4.7	5.8	6.2	26.4	69	106
600		1.5	3.1	4.9	6.1	7.1	30.2	75	117
700		1.6	3.3	5.2	6.5	8.0	34.2	85	132
800		1.7	3.4	5.5	6.8	9.1	36.3	95	145
900		1.8	3.6	5.7	7.1	10.2	40.7	102	158
1000	1	1.9	3.7	5.9	7.4	11.3	43.0	109	172
	2	2.3	4.6	7.4	9.3	16.6	66	172	271
	3	2.7	5.3	8.5	10.6	22.9	88	227	353
	4	2.9	5.8	9.3	11.7	26.4	106	272	430
	5	3.1	6.3	10.1	12.6	30.2	125	320	499
	6	3.3	6.7	10.7	13.4	34.2	141	360	564
	7	3.5	7.1	11.3	14.1	38.5	158	401	625
	8	3.7	7.4	11.8	14.7	43.0	172	437	679
	9	3.8	7.7	12.3	15.3	45.4	186	475	735
	10	4.0	7.9	12.7	15.9	50	196	507	794
	11	4.1	8.2	13.1	16.4	53	211	539	845
	12	4.2	8.4	13.5	16.9	55	222	573	897
	13	4.3	8.7	13.9	17.3	58	238	607	940
	14	4.4	8.9	14.2	17.8	61	249	633	995
	15	4.5	9.1	14.5	18.2	64	260	661	1040
	16	4.6	9.3	14.8	18.6	65	272	688	1087
	17	4.7	9.5	15.1	18.9	69	284	716	1122
	18	4.8	9.7	15.4	19.3	72	296	745	1170
	19	4.9	9.8	15.7	19.7	75	302	774	1219
	20	5.0	10.0	16.0	20.0	79	314	804	1257
	25	5.4	10.8	17.2	21.6	92	366	929	1459
	30	5.7	11.4	18.3	22.9	102	405	1052	1647
	35	6.0	12.1	19.3	24.1	113	460	1170	1825
	40	6.3	12.6	20.2	25.2	125	499	1282	1995
	45	6.6	13.1	21.0	26.2	137	539	1385	2157
	50	6.8	13.6	21.7	27.1	145	581	1479	2307

RADIUS and area of various degrees of damage from high air burst of A bombs or H bombs. Radius is measured from ground zero (1 kiloton is 1000 tons; 1 megaton is a million tons)

People everywhere are badly confused about A bombs and H bombs. Dispelling this confusion is a public duty for every engineer. Here are some unvarnished facts.

ment of Defense and the Atomic Energy Commission. This was published in 1950 by the McGraw-Hill Publishing Company.

Page 55 of this book states that the radius of a given degree of blast destruction varies as the cube root of the energy of the bomb.

Pages 134 and 136 give the following radii for the original (Bikini) 20-kiloton bomb:

Virtually full destruction, 0.5 mile
Severe damage, 1 mile
Moderate damage, 1⅝ mile
(we call it 1.6)
Partial damage, 2 miles

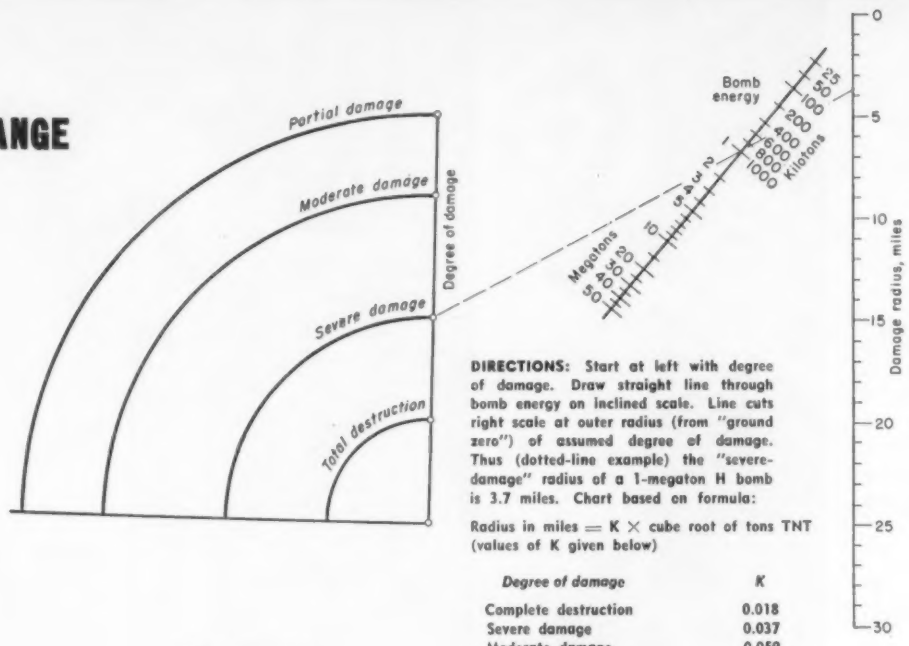
Because assessment of damage in these terms is somewhat vague, I have avoided unwarranted refinement in the computation. Radii are tabulated to the nearest tenth of a mile. From these radii, in turn, areas are computed to the nearest tenth of a square mile up to 50 square miles—beyond that to the nearest square mile.

As stated above, the radius of a given degree of damage from the shock wave varies as the cube root of the bomb's energy. Multiplying the bomb's energy by 8 merely doubles the damage radius. Multiplying energy by 27 triples the damage radius. Multiplying energy (say, by jumping from a 20-kiloton A bomb to a 20-megaton H bomb) by 1000 multiplies the damage radius by 10.

It follows that *area* of destruction increases much more slowly than the bomb's energy, since area varies as the square of the radius, or as the square of the cube root of the energy.

What happens when a bomb is made 8 times as powerful? We take the cube root of 8 to get 2 and square this to get 4. So a bomb 8 times as powerful will destroy only 4 times as much area. And a bomb 27 times as powerful will destroy only nine times as much area.

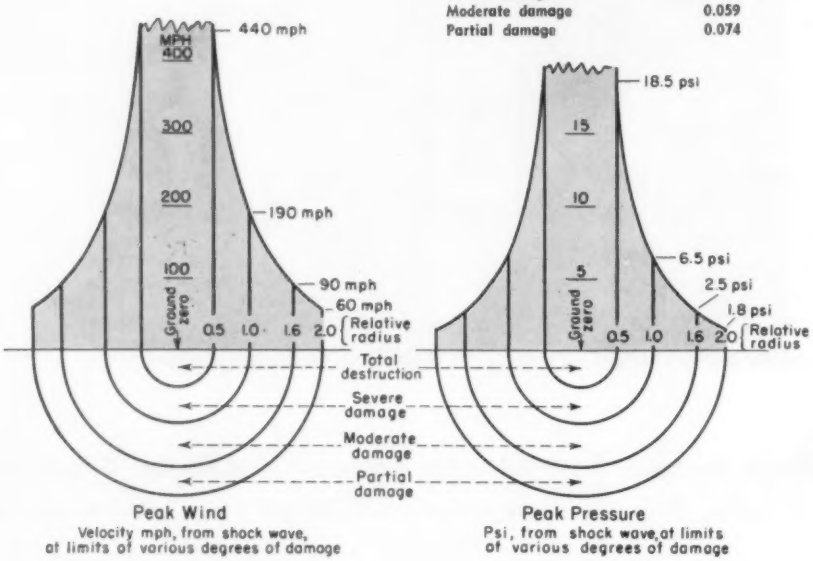
(*Continued on page* 83)



DIRECTIONS: Start at left with degree of damage. Draw straight line through bomb energy on inclined scale. Line cuts right scale at outer radius (from "ground zero") of assumed degree of damage. Thus (dotted-line example) the "severe-damage" radius of a 1-megaton H bomb is 3.7 miles. Chart based on formula:

Radius in miles = K × cube root of tons TNT (values of K given below)

Degree of damage	*K*
Complete destruction	0.018
Severe damage	0.037
Moderate damage	0.059
Partial damage	0.074



Peak Wind
Velocity mph, from shock wave, at limits of various degrees of damage

Peak Pressure
Psi, from shock wave at limits of various degrees of damage

Universal bomb charts for structural engineers

I have plotted these three charts from officially published data for the original 20,000-ton (TNT equivalent) A bomb and from the scaling law that the radius of any given intensity of shockwave effect increases as the cube root of the energy of the bomb.

The charts hold true for a bomb of any size from the original A bomb to the largest H bomb. No matter how powerful the bomb, the radii from ground zero to the limits of total destruction, severe damage, moderate damage and partial damage, respectively, will be in proportion to the numbers 1, 2, 3.2 and 4.

Top chart gives the actual radius in miles of any degree of damage from a bomb of any power. Having determined this radius, the puff-wind velocity and pressure (above atmosphere) of the shock-wave front reaching that radius will be as plotted in the two lower charts.

These three charts give structural engineers the data they need to design structures (shelters, etc) to stand up at a specified distance from a bomb of specified strength. Pressure lasts long enough to be figured (roughly) as a static pressure. Safety factors will naturally be more skimpy than in commercial work.

It follows that the efficiency of an H bomb, expressed as area destroyed per unit of energy, varies inversely as the cube root of the energy. The bigger the bomb, the less the efficiency. Multiplying the power of a bomb by 1000 divides its efficiency by ten. *Per unit of energy,* a 20-kiloton bomb destroys ten times as much *area* as a 20-megaton bomb.

Note, also, that the larger bomb has a lower "target efficiency," meaning the degree to which the outer circles of destruction are solidly full of worthwhile objectives.

It is perhaps fortunate that the destructiveness of an H bomb is not proportionate to its energy. Consider an H bomb of 8 megatons (8,000,000 tons TNT), a size supposedly surpassed in the Pacific tests. This is equivalent to 100 lb of TNT for every one of the 160,000,000 men, women and children who inhabit the United States. Now it needs no arithmetic to show that 160,000,000 TNT charges of 100 lb each, properly distributed, would do vastly more damage than a single 8-megaton H bomb, or, in fact, than a single hill of 16 *billion* pounds of TNT.

To measure the relative effectiveness we take the cube root of 160,000,000. This is 540, so the energy of the smaller charges would be used 540 times as effectively in terms of area destroyed.

Note that *the table is for shock-wave blast damage only.* The other important effects are radiant heat and gamma radiation. For the original 20-kiloton atomic bombs, radiant heat ignites exposed combustibles at a distance of more than a mile.

For the same bomb the "median lethal" range of the gamma radiation (range at which exposed people have a 50-50 chance of survival) is about 3500 ft from ground zero.

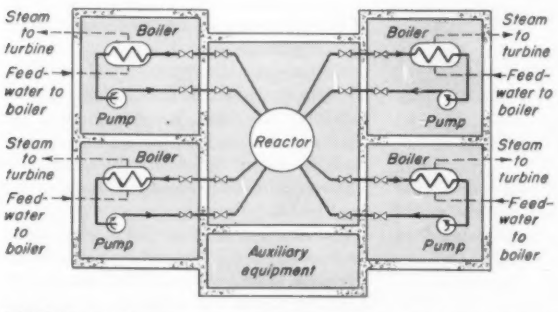
Radiant heat and gamma rays do not follow the cube-root scaling law. The book, *Effects of Atomic Weapons,* gives information regarding their range in relation to the energy of the bomb.

GE predicts competitive atom power in 10 years

Says plant sending steam to turbine from boiling water in reactor will deliver net kwhr for 1.35 mills fuel cost, 6.7 mills total cost. Westinghouse outlines the design of 60,000-kw plant

► COMPETITIVE POWER from atomic plants in ten years was predicted by Francis J McCune at the Atomic Industrial Forum Panel in Washington on May 24. McCune is general manager, Atomic Products Division, General Electric Co. The Forum Panel meetings were attended by some 500 electric utility and other experts gathered to hear talks by the proponents of the various reactor types.

By 1964, McCune predicted, the electric-utility industry will own and be operating a number of atomic power plants, and these, constructed and operated without government subsidy, will be competing with conventional power plants. He also stated that the two nuclear reactors offering the greatest promise for rapid development and competitive use are (1) the reactor that is both moderated and cooled by ordinary (light) boiling water and (2) the reactor moderated by graphite and cooled by ordinary water.



LAYOUT of Duquesne project, the world's first large atomic power plant. Steam generator is water-to-water heat exchanger

At the same meeting Charles H Weaver, manager of the Atomic Power Division of Westinghouse, made public some of the design features of the 60,000-kw atomic power plant that will be built on the banks of the Ohio River about 25 miles from Pittsburgh.

Westinghouse reveals atom plant data

This will be the world's first large-scale atomic power plant. The reactor and heat-exchanger plant will be designed by Westinghouse under contract with the AEC. Stone and Webster will handle the general engineering of the power plant. Duquesne Light Co will furnish the site and operate the entire plant, purchasing steam produced by the reactor plant.

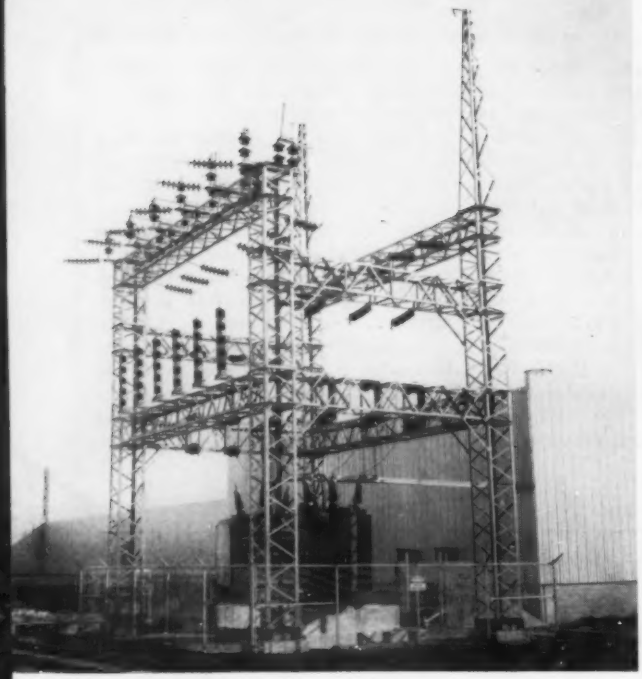
Fuel will be slightly enriched natural uranium. The reactor will be cooled and moderated by ordinary water, under 2000-psi pressure to prevent boiling. This primary coolant, delivered to heat exchangers, will generate "power steam" at 600 psi or higher. Further details will be found at the end of this report.

General Electric report

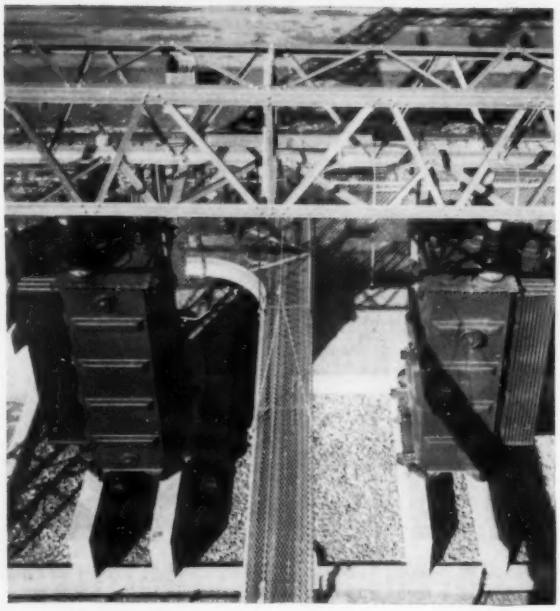
For estimating atom-power costs, the General Electric studies allow 13.7% fixed charges on plant, 11.4% on land and 9.6% on "nuclear fuel inventory," taken as 60% of one reactor charge. The initial cost of nuclear fuel for one large reactor may be as high as 40 million dollars. The treatment of this inventory thus has a significant effect on all the cost comparisons.

As soon as the reactor starts, the value of this inventory begins to decrease as the fuel is gradually consumed. After a year or so, when the schedule of loading new fuel and

(*Continued on page* 174)



PRIMARY SUBSTATION transformers drop incoming 66 kv to 480 v. Conductors, aluminum; structure, 61S-T6 aluminum alloy



CABLE MESH-TRAY, *(front),* contains 1000 Mcm RH/RW aluminum cable, two per phase, feeding 480 v to indoor switchgear

Alcoa's newest plant shuns load centers in favor of . . .

. . . A 480-v closed loop for electrical

Plant loop fed by a single outdoor 66 kv/480 v sub

- **The trend for years in industrial plant distribution has been toward high-voltage load centering (Power, Oct 1953). Yet Alcoa engineers felt a low-voltage loop best met this plant's needs and at lowest cost**
- **Aluminum used as conductor, substation structure, conduit. See pp 107, in this issue, for how-to information on working with aluminum**
- **480-v neutrals are ungrounded**
- **Grounded mid-taps on secondary of 120-v transformers hold voltage-to-ground to 60 v: a safety item**
- **Plug-in bus duct gives added flexibility for future machine changes**

By J M BALES, *Electrical Engineer*
and F A GUNTHER, *Staff Engineer*
Aluminum Company of America

► THE LANCASTER (PA.) WORKS is the latest plant of the Aluminum Company of America. It consists of a single-story concrete-block structure, 480 by 420 ft, with a 2-story office building at the front and a boilerhouse at the rear corner. If future growth demands, we can expand the plant on three sides. All outside walls are covered with formed aluminum sheets having a glare-reduction finish. Plant will produce aluminum fasteners (bolts, screws, washers, etc) and other screw-machine products.

UTILITY SUPPLY

Total plant load breaks into 2847 hp of connected motors, 362 kw connected resistance-type load, and 375 kw connected lighting. Estimated demand factor is 60% with a 35% load factor.

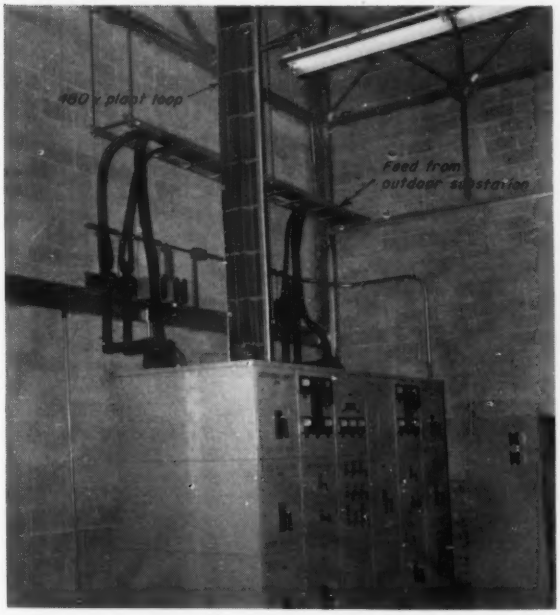
Primary substation. Pennsylvania Power and Light Co offered contracts at 480 v, 12 kv and 66 kv. Estimated energy consumption was translated in terms of each contract and, based on over-all energy costs, we selected the 66-kv service.

Also, a cost comparaison was made between using three single-phase transformers and one 3-phase unit in primary substation. We decided a single 3-phase transformer, rated 1200 kva at 66 kv/480 v, was the most economical. Although two delta/delta transformers were installed, one is now a spare. If needed, we can add a third transformer. Capacitors totalling 480 rkva were installed, correcting pf to about 94%.

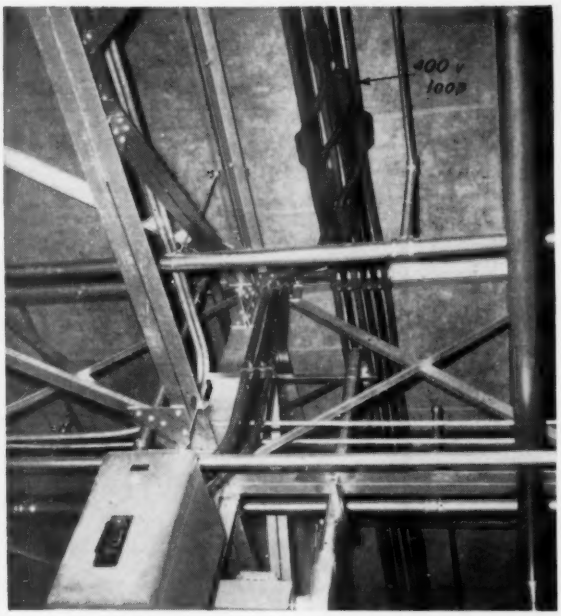
Substation design. Substation was designed for easy expansion should load growth warrant. Use of oisc (oil-immersed, self-cooled) transformers required substation be located at least 25 ft from nearest building to meet modern safety practices.

Substation structure is of 61S-T6 aluminum, chosen because of its ability to resist corrosion, hence reducing future maintenance. Final substation design included interlocks on incoming 66-kv circuits to prevent paralleling, except by the power company.

In contrast to the usual steel substation requiring complete field assembly with bolted joints, the substation at Lancaster with its aluminum structure permitted partial preassembly. Partial assemblies of latticed columns and



MAIN SWITCHGEAR houses electrically-operated 50,000 rms amp IC breakers. Plant 480-v loop starts and ends here



LOAD BREAKERS, spotted on columns, are fed from open loop. Each breaker-lead taps into, and ties together, loop halves

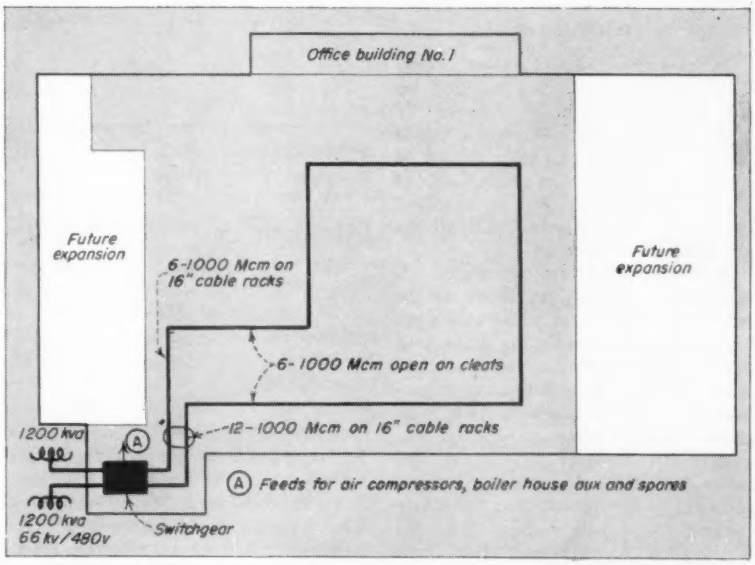
distribution

trusses with riveted joints were made at the factory. Lightweight structure required less field labor for normal handling, erection and assembly than if steel were used.

All substation conductors are No. 1/0 aluminum with welded aluminum terminals. Bolted aluminum parallel-groove clamps were used for tap connections. Secondary connections from the 480-v transformers to indoor switchgear are made with insulated 1000-Mcm type RH/RW aluminum cable; two cables per phase on aluminum racks.

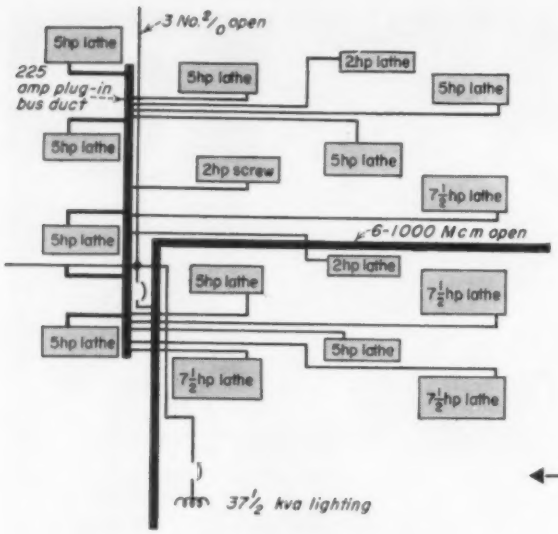
Because transformer switching was infrequent, separate disconnecting switches were not installed for each transformer. If it is necessary to take a transformer out of service, the substation is de-energized at a convenient time. Insulation level is the same as that of the power company: seven 10-in. disk insulators per string.

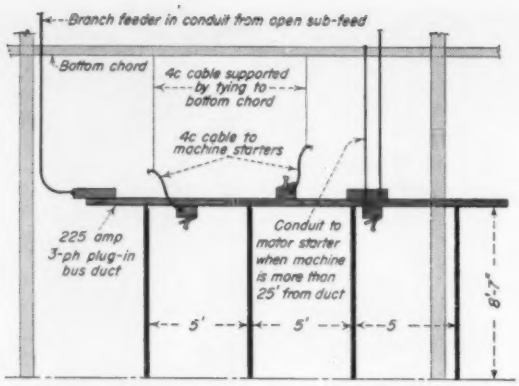
Expansion. If plant power demand increases sufficiently to warrent installing a third transformer, additional disconnecting fuses will be added. These would be mounted outside the substation structure, back to back with one of the



Aluminum cable on open cleats forms a closed loop over load areas

Single 3-phase 1200-kva transformer in outdoor substation feeds metal-enclosed switchgear within plant. Switchgear aluminum bus is braced for a 75,000-amp short circuit. Main breakers in 480-v leads from substation transformer are rated 1600 amp. The 480-v closed loop runs through plant at roof-truss level and is tapped to air circuit breakers feeding individual or multiple loads. Where plug-in duct is used, connections are made to machines by neoprene-jacketed 600-v 4-conductor cable kept taut by spring tension.




Branch feeder in conduit from open sub-feed
Bottom chord
4c cable supported by tying to bottom chord
4c cable to machine starters
225 amp 3-ph plug-in bus duct
Conduit to motor starter when machine is more than 25' from duct
5'
5'
5
8'-6"

STEEL SUPPORTS on 5-ft centers hold duct firm. Each 2-in. support is welded to ½-in. x 1-ft plate, lag-bolted to floor

BUS-DUCT RUNS usually fed at about center of electrical load on duct. Fusible plug-in disconnect used with each machine

Plug-in bus duct eases future shifting of plant machines

present fuse sets. Such a design permits installing the third transformer without expanding the structure.

SWITCHGEAR

Metal-enclosed drawout-type switchgear with aluminum bus, adopted for the 480-v switchgear, is fed directly from the substation. Aluminum bus is braced for 75,000-amp short circuit, or 25,000 amp greater than available. Load cables entering gear were so arranged that easy access could be had to all bus and breaker connections.

Breakers in this switchgear are all electrically operated and have an interrupting capacity of 50,000-rms amp. Switchgear breakers in the 480-v feed of the transformer are rated at 1600 amp. These breakers connect to a common bus made of three ¼×4-in. aluminum bars per phase.

All load breakers connect to this bus. Two 1600-amp circuit breakers, identical to the transformer secondary breakers, feed both ends of the main distribution loop circuit that runs through the plant. In addition to the conventional red and green lamps that indicate breaker position, these breakers have an additional set of lights to show back-feed.

Two electrically operated 300-amp breakers control the 200-amp synchronous motors driving plant air compressors. These breakers are equipped with conventional synchronous motor starting, protection, and field application relays. Synchronous motors have an 0.8 leading pf. Remaining breakers in this switchgear are the standard feeder type.

All breakers are equipped with three dual magnetic overload trips. The instantaneous overcurrent trips are set at 12 times breaker rating.

DISTRIBUTION

Electrical power is distributed through the main plant over a closed loop. This loop, at level of plant roof trusses, passes over all concentrated load areas. Taps to loop are made through air circuit breakers feeding individual or multiple loads.

Plug-in aluminum bus duct was installed where there were sufficient individual loads in one area. Usually bus duct was fed at about the center of the electrical load. Connections from duct to individual machines are made with fused plug-in disconnects. Individual machines connect to these switches by open, flexible, neoprene-jacketed, 600-v, 4-conductor cable, kept taut by spring tension.

Plug-in bus duct was selected to permit future machine rearrangements that may come about either by plant growth or special shop-setup arrangements to meet changing production needs.

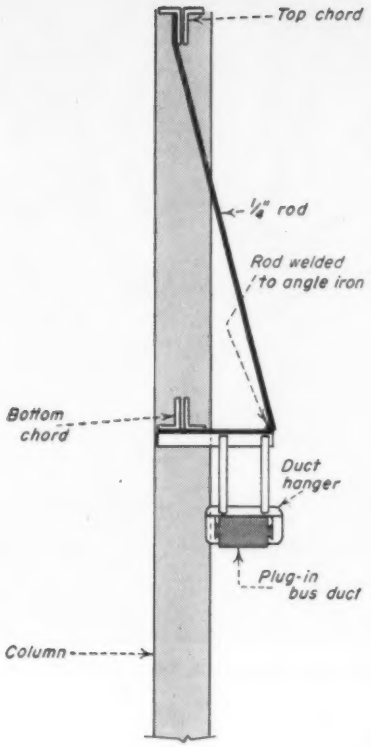
Alcoa considers the closed loop system offered maximum flexibility at mini-

Here is the complete connected motor load

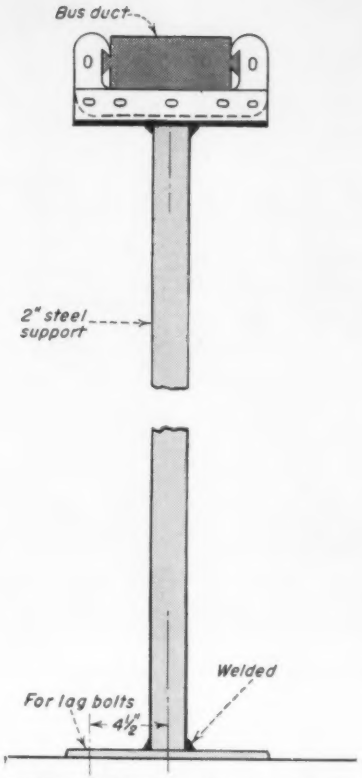
Hp	Production machines 3-ph 440-v squirrel-cage single speed	multispeed	Dc supply 250 v	Maintenance shop 3-ph 440-v squirrel cage	Service 3-ph 440-v
¼	17			12	
1/3	10			3	5
½	103			6	11
¾	25			4	24
1	37			3	9
1½	38			9	32
2	49			6	29
3	63		2	7	7
5	63	7	1	3	7
7½	48		1	1	6
10	11		1	2	2
15	6	1			5
20	10				
25	1				4
30					1
40					3
75					2
200				(synchronous)	2
Total hp 1558 5/6		50	28½*	102	1136 1/6

*Fed from mg set

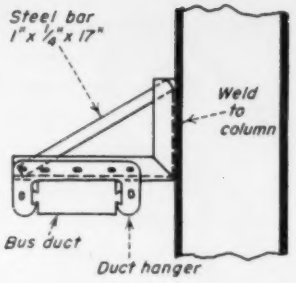
Total motor load = 2847 hp



DUCT HANGER, plus supports from top, bottom chords, hold bus duct in position



FLOOR SUPPORTS simplify fastening duct while keeping bus close to the machines



ANGLE-IRON brace for bus duct when next to wall or on row of steel columns

mum cost in this plant. Load-center type of distribution would not lend itself to our specific requirements as readily as the low-voltage loop and plug-in system.

Closed loop design. Load estimates were based on studies of Alcoa's existing plants, making allowances for lighting, heating, ventilating, and estimated load growth in this specific plant. Maximum load that can be fed by loop is about 2000 kva.

Loop is made up of two 3-phase 480-v runs of 1000-Mcm aluminum cables with type RH/RW 600-v insulation and a neoprene covering. Total loop capacity is 3140 amp. All cable in the loop was installed open on insulated cleats with conductors horizontal, side by side. The phasing is ABC, ABC. Bolted aluminum parallel groove clamps are used to parallel the loop where heavy taps are made to the loop. Load is balanced between alternate cables in loop.

Loop advantages. Present loop capacity allows for substantial load growth in area served by loop. Wiring methods other than open cable loop could have been used. Examples: radial armored cable feeders or cable in conduit. However, there were definite advantages in using the loop. Among them are low first cost, ease in tapping, better regulation, lower voltage drop, less feeder cable, fewer circuit breakers. One significant advantage is the ease and practicality of tapping this loop at any point to feed individual loads.

Cost of 1000-Mcm aluminum cable, installed on insulating cleats two cables per phase, is less than 50% equivalent current-carrying capacity cable installed in conduit. However, the cost of low-impedance aluminum bus duct, even with tapering capacity at the outer ends, is substantially more than that of cable in conduit. Voltage drop in bus duct compares favorably with cable in conduit.

If copper had been used for the open cable, feeder costs would have been about 25% higher. This comparison is based on costs of two 750-Mcm copper cables in place of two 1000-Mcm aluminum cables per phase, using February 1954 prices.

Ungrounded 480 v. Permanent neutral grounding was not adopted on the 480-v secondary system. However, indicating ground lights are installed on the 480-v switchgear. When a ground occurs on one phase, the affected equipment can be taken off the line and repaired at a convenient time. If the equipment involved is essential for plant operation or if for some reason it would be undesirable to shut down the affected machine at the time ground occurs, it can be left on the line temporarily until a more convenient time for repairs is available.

If 480-v system neutral were grounded at substation or switchgear, a single ground fault on any phase would trip affected circuit off the line. And it couldn't be returned to service until the ground was cleared. Tripping off the faulted circuit simplifies locating the ground, but it also means immediate downtime for machine, feeder and personnel, until the ground is cleared. Also, a grounded neutral system requires three overload relays on each motor, at some extra cost.

It has been Alcoa's experience that an ungrounded secondary system is least expensive, both in first cost and in operation.

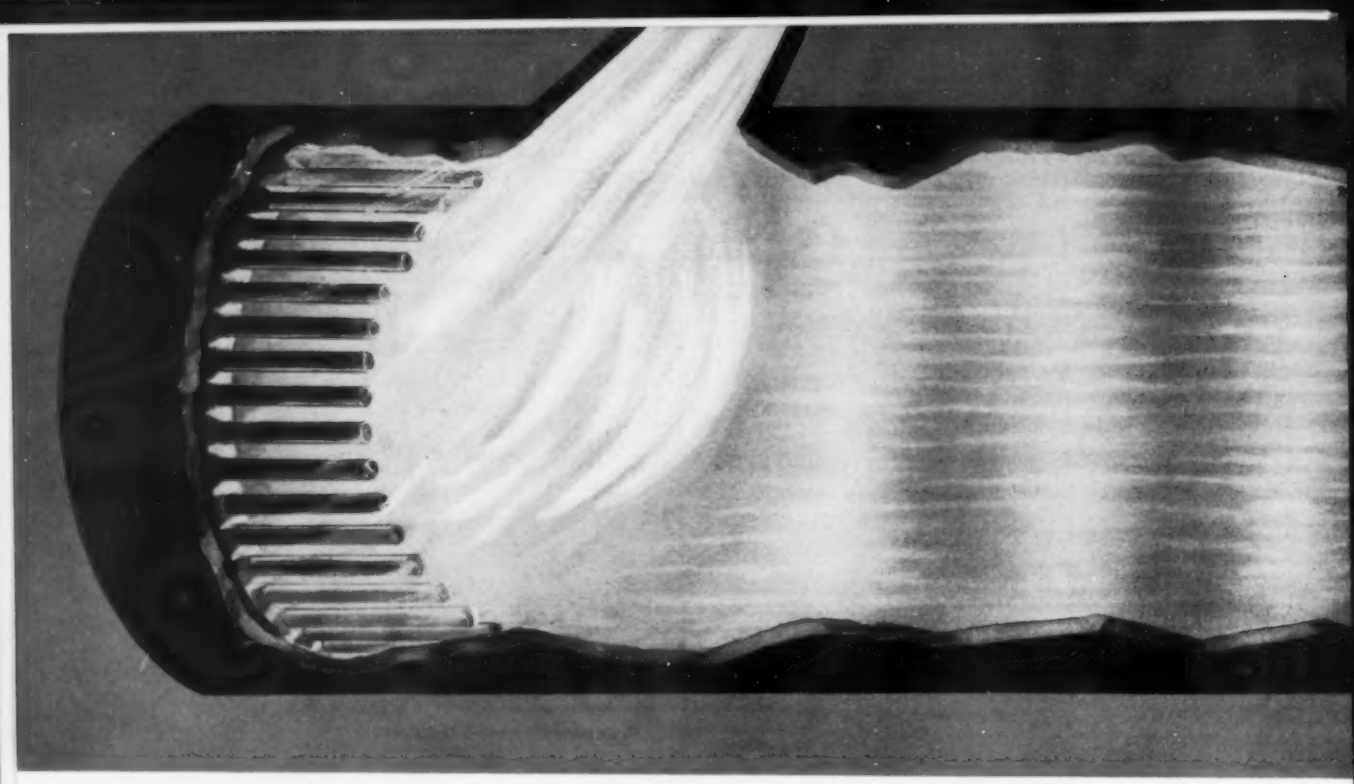
PLANT LOADS

Induction motors form a large bulk of the motor load. These are primarily single-speed 4-pole squirrel-cage units. A few rivet-heading machines have multispeed squirrel-cage motors. Some motors are open, others totally enclosed fan-cooled, depending on local conditions. Each motor has its own thermal overload protection and fused safety switch. Most motor control enclosures are NEMA type 1A.

Dc needs for five machines requiring stepless speed control are provided by a 75-hp mg set developing 50 kw at 250 v. This mg set is close to the dc load center.

Single-phase loads. Small 120-v single-phase motor loads and receptacles for portable tools are fed from 480/120-

(*Continued on page* 194)



ARTIST'S CONCEPTION of the pulsating-combustion furnace of the future. The burner sets up pressure wave that will . . .

Pulsating combustion: An old idea may

Pulsating or flash combustion depends on resonating pressure waves for its operation. These waves break up slow-moving layers of gas along tube walls, increasing heat-transfer rate. In this first of two articles we examine wave action and show similarity of the pulsating furnace to an oversized organ pipe

By **HOWARD KALLEN**, *Assistant Editor*

► BASICALLY, only two processes are involved in generating steam: (1) conversion of the fuel's chemical energy to heat (2) transfer of this heat to the feedwater and steam. How efficiently we perform these functions depends to a great extent on the fuel-burning technique used in the furnace.

Burners for today's steam generators provide a smooth, steady flow of fuel and air to a combustion chamber where burning takes place at a constant rate, followed by expansion of the hot gas. At no time in the cycle does the combustion rate or pressure exerted by the gas particles vary appreciably. We call it the *constant-pressure method*. An entirely different method, *pulsating combustion*, has several advantages over today's methods—and some disadvantages. The idea actually uses a series of controlled explosions, which generate the hot gas whose pressure fluctuates at the speed of sound. While some promising work has been done along these lines, notably in Europe, much more development remains to be done in the steam-generation field, before all the answers are in, and evaluated.

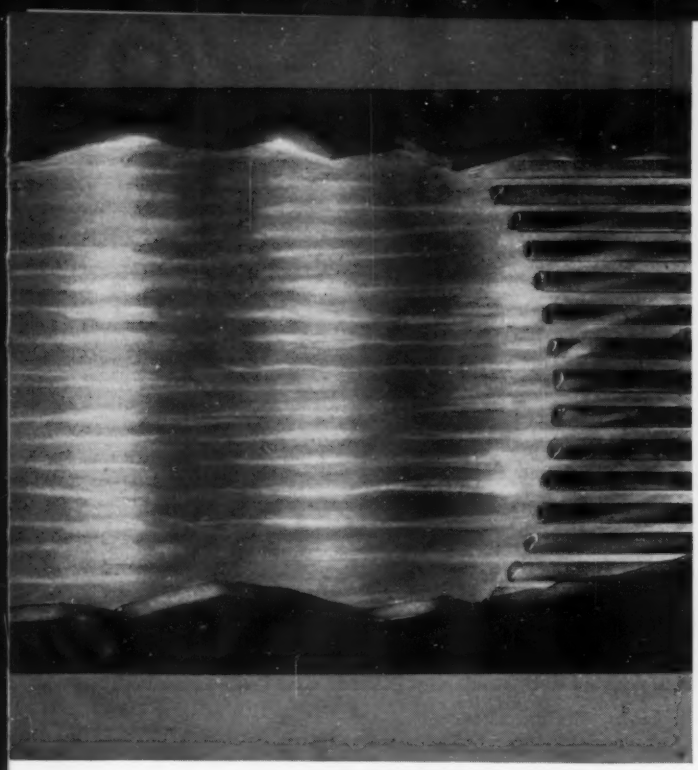
Theory. Because operation of the pulsating-combustion boiler depends on the physical nature of pressure waves, we're going to take a close look at basic-wave theory. Then, armed with the fundamentals, we'll see how a standing pressure wave of furnace-gas particles acts to produce some of the advantages claimed for pulsating combustion—higher rates of heat release, and increased heat transfer.

We can picture any gas as a series of particles side by side. If one of these particles is set in motion, its neighbor follows with the same motion a fraction of a second later. This action proceeds throughout the gas. After a short time, the first particle or particles displaced reach a maximum distance from their neutral position, return to neutral, and then swing in the opposite direction. Thus, the disturbance travels as far as the gas extends, but each particle moves only a short distance, stops and instantly swings the other way. Without going into details, we've just described a simple vibration or wave motion.

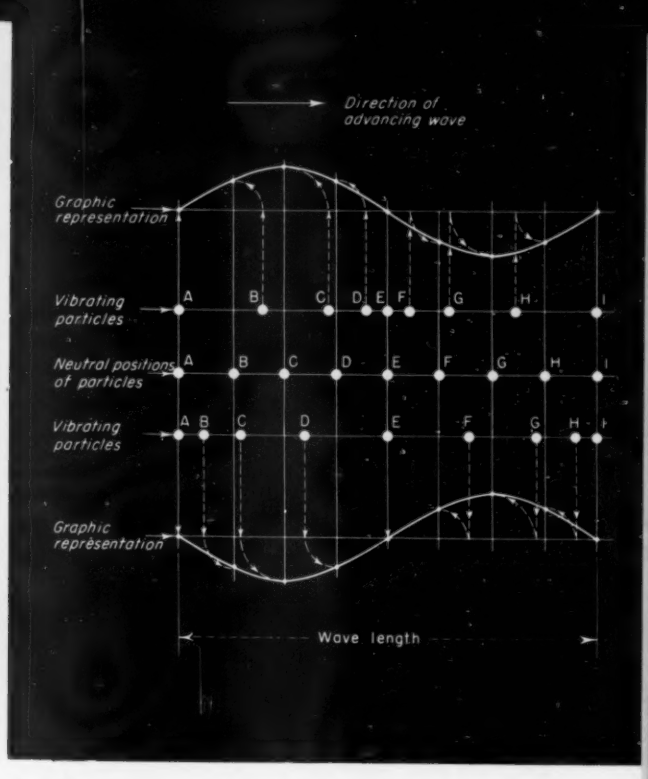
Wave speed through the gas can be calculated from the following equation:

$$V = \sqrt{kpg/d} \qquad (1)$$

Since gas density varies inversely with absolute temperature, formula (1) also



. . . cause the furnace gas to perform resonant vibrations


Direction of advancing wave
Graphic representation
Vibrating particles
A B C D E F G H I
Neutral positions of particles
A B C D E F G H I
Vibrating particles
A B C D E F G H
Graphic representation
Wave length

RELATION between actual wave and its graphic representation

give tomorrow's boilers a new look

tells us that wave velocity is proportional to the square root of absolute temperature. By applying the general gas law, which may be written:

$$pv = RT \qquad (2)$$

and substituting RT for p/d, we get:

$$V = \sqrt{kgRT} \qquad (3)$$

Wave velocity therefore depends on absolute temperature.

Wave length is the distance between the two nearest particles that are moving in the same direction and are in the same relative position with respect to their neutral points. See drawing, *at top right*. These two particles are also said to be in *phase* with each other. Frequency, as the name implies, is nothing more than the number of wave lengths or cycles sent out by the wave source in a given period of time. Common unit is, therefore, cycles per second. We can calculate wave velocity through the gas simply by multiplying wave length by its frequency:

$$V = L \times f \qquad (4)$$

But remember that wave velocity depends only on the physical factors in equations (1) and (3). So, if we change frequency of vibration, wave length must change proportionately to keep V constant— as long as factors in equations (1) and (3) don't change.

So far we've talked about wave velocity: a constant speed for gas at a specific temperature. The gas particles themselves are also moving. Gas velocity is always varying, depending on distance from the neutral position. Maximum velocity takes place as particles pass through neutral. They gradually slow down as they reach the end of their swing and come to a halt to reverse direction of movement. Picture a swinging pendulum. Motion of the gas particles is much the same.

Particle velocity depends on wave velocity, change in pressure caused by the wave, and the pressure of the undisturbed gas particles:

$$w = (V/k) \times (\Delta p/p) \qquad (5)$$

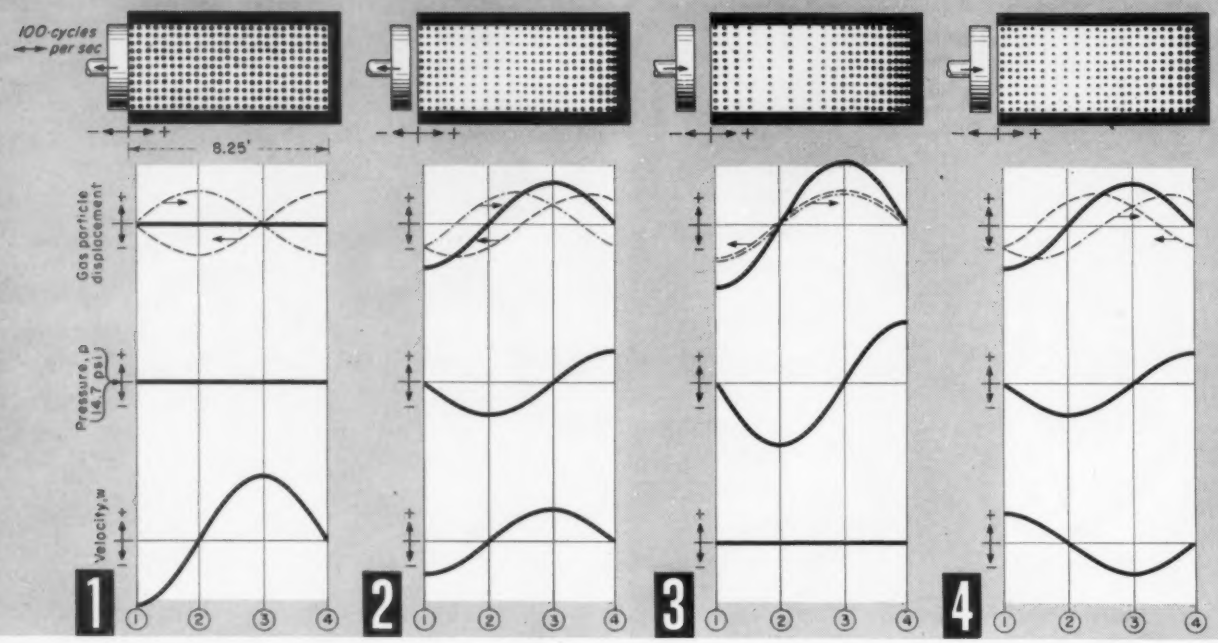
Study of equation (5) also tells us that when pressure increases (Δp positive) the wave and gas particles are traveling in the same direction. When they travel in opposite directions, pressure decreases (Δp negative).

Now let's see how we can set up the wave required to successfully operate

(*Continued at bottom of page* 90)

SYMBOLS

V = wave velocity, ft per sec
k = ratio of specific heat at constant pressure to specific heat at constant volume
p = gas pressure, lb per ft²
d = gas density, lb per ft³
g = gravity constant, 32.2 ft per sec²
v = specific volume, ft³ per lb = 1/d
T = absolute temperature, Rankine
R = gas constant, 53.4 ft lb/lb-F for air
w = gas-particle velocity, ft per sec
Δp = increase or decrease in gas pressure, corresponding to w
L = wave length, ft
f = frequency, cycles per sec
n = 1/2, 3/2, 5/2, ...
c = column length, ft



This series of 8 wave pictures is presented so pressure waves will mean something more to you than just a series of formulas. We're going to observe the action of a pressure wave in a column closed at one end. To do this, we'll equip ourselves with a very high-speed camera: one capable of taking a picture in practically no time at all, thereby freezing the motion of the gas particles for examination at our convenience. These pictures have been taken at .00125-sec intervals. The wave travels 1.375 ft during one time interval. This is figured from:

Wave travel distance = time interval × wave velocity
= .00125 sec × 1100 ft per sec
= 1.375 ft

This distance represents 1/6th of the column length.

Now let's look at drawings 1 to 8, above:

1 All gas particles are shown in their neutral positions, vibrating at 100 cycles per sec, figured from equation (6). Piston representing wave source is also vibrating at 100 cycles per sec. Displacement waves are represented graphically by method in diagram, p 89. Impressed wave, dot-dash curve in top graph moving to right, is caused by force due to oscillating piston. Reflected wave, dash curve moving to left, is due to wave force reflected from closed end of column. At the instant first picture is taken, these two forces nullify each other throughout the gas. Result: All particles are in their neutral positions, as shown by heavy horizontal line. Pressure graph shows uniform distribution throughout when gas particles are equally spaced.

Although all particles are in their neutral positions they are actually moving with maximum velocity, as in bottom graph. Notice that velocity is zero at stations 2 and 4. Because of continuous balance here of advancing wave by reflected wave, these particles never move. These regions are called *nodes* or *nodal points*. Stations 1 and 3—points of maximum displacement—are called *antinodes*.

2 .00125 sec later, advancing and reflected waves partly nullify, partly reinforce each other. Resultant wave, heavy solid curve, is just an average of the two. Pressure curve follows density of gas particles. Particle velocity decreases as maximum particle displacement is approached.

3 After .0025 sec, the advancing and reflected waves are completely in phase: total reinforcement occurs. Maximum pressure *changes* take place where gas-particle movement is zero. Particles on either side of these points, moving in opposite directions, either crowd in or swing away from each other. Where pressure is maximum we get a dense particle distribution, called a *condensation*. Where pressure is a minimum, relatively fewer particles appear, called a *rarefaction*.

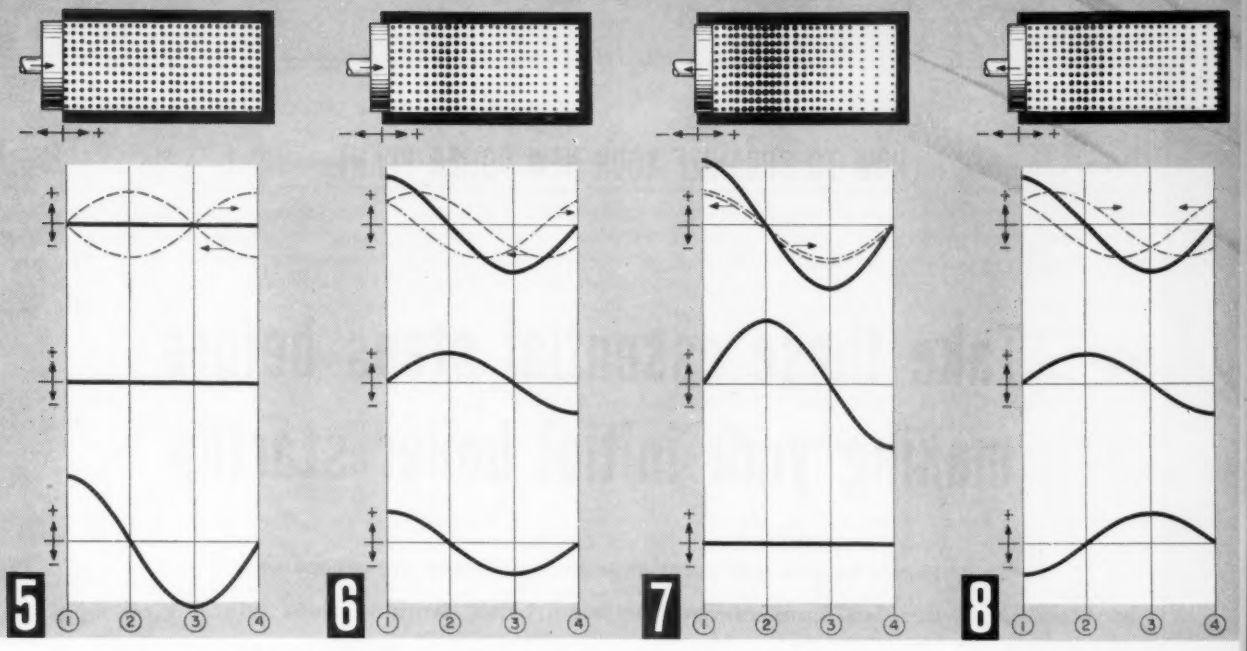
Because all particles have reached the end of their swing, they come to rest and change direction. Velocity graph, therefore, shows gas at rest.

Pulsating gases: their displacement, velocity and pressure

a pulsating-combustion furnace. We'll let an air column, at atmospheric pressure and temperature and closed at one end, represent a highly simplified furnace. The fact that furnace gas is at much higher temperatures and of different composition only means that the pressure wave will travel at higher velocity. Principle is still the same.

Vibrating frequency of our wave source depends on its own physical characteristics: mass, rigidity, damping. This is known as its *natural frequency*. Wave velocity in air column can be figured from equation (1) or (3). For our conditions it's about 1100 ft per sec. This figure is also the velocity of sound at atmospheric conditions. Sound, therefore, is nothing more than a pressure wave at audible frequency.

Our air column also has a natural frequency. At the calculated wave velocity, natural frequency depends on column length. By selecting column length so natural frequency of the wave source is the same as of the air column, we reach a condition known as



4 After .00375 sec, picture shows an intermediate position like 2. Only difference: Gas particles are now approaching their neutral rather than extreme positions.

5 After .0050 sec, we again get a uniform gas distribution. Uniform pressure graph naturally follows when all particles are in neutral positions. Velocity graph shows that all regions are again moving at their maximum speeds. Stations 2 and 4 are always at rest because they are nodal points. If we compare this velocity distribution with that of Fig. 1, we find that the two curves are completely opposite in direction. In Fig. 1, gas particles between stations 2 and 4 are moving in same direction as wave. Between stations 1 and 2, gas movement is opposite to wave direction. The reverse situation is true for Fig. 5.

6 After .00625 sec, the condensation begins to appear at station 2. Rarefaction starts to show up at closed end. Particles are again approaching the end of their swing. But this time, region between stations 2 and 4 is displaced to the left, while region between stations 1 and 2 is displaced to the right.

7 After .0075 sec, the advancing and reflected waves again fully reinforce each other. Comparing this with Fig. 3 we see that the condensation has moved from station 4 back to station 2. The net effect has been to produce a *standing wave.* The physical action can be likened to an accordion: particles alternately swing toward or away from each node.

8 After .00875 sec, drawing pictures gas just before Fig. 1 would again appear, thus completing a full cycle. Time for this is .0100 sec. We call this the *period.* Notice that it's nothing more than the reciprocal of the frequency.

You've probably already noted that when maximum and minimum pressures occur, particle velocity throughout gas is zero, and vice versa. There's a good reason for it. Total mechanical energy of the particles, as received from the wave motion, is in the form of potential energy, kinetic energy, or a combination of the two. When velocity is zero, kinetic energy is also zero. Energy added to gas by the wave is then entirely in potential form. When gas velocity reaches maximum, wave energy has been transferred to kinetic form.

We have actually observed a continuous, back-and-forth transformation of the wave-energy form in the gas. It is this action in a furnace that is capable of breaking up the dormant, slow-moving layers of gas next to tube walls, thereby boosting heat-transfer rates. It can be imagined as a scrubbing effect. As a brief example of what might be expected, at the present time furnace-gas velocities range from 20 to 60 ft per sec. Pulsating flow could superimpose a maximum particle velocity of 900 ft per sec on today's figures. But enough, for now, on how this wave theory is applied to a pulsating-combustion furnace.

Next month, F H Reynst, a leading European engineer, will go into some application details: where they stand today, what may be ahead for the future.

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behavior patterns show they can boost heat-transfer rates

resonance. This just means that the wave-source vibrations reinforce the air-column vibrations.

We'll assume that the natural frequency of the wave source as represented by the oscillating piston is 100 cycles per sec. From equation (1), we've already said that wave velocity is approximately 1100 ft per sec. By setting column length at 8.25 ft, we can figure the natural frequency of the air column from:

$$f = nV/2c \qquad (6)$$

When n is ½, we get the fundamental or lowest natural frequency. For n equal to 3/2, a higher-order natural frequency exists. Musicians call it the third harmonic. This, incidentally, is exactly what happens in an organ pipe. In our case let's assume that we've set up the third harmonic. Then, equation (6) tells us that the air-column frequency is also 100 cycles per sec—establishing resonance. To see how this comes about, let's take a close look at the series of drawings above.

HOW TO ORGANIZE YOUR NEW POWER PLANT—9

Take these essential steps before making your initial boiler startup

Here's how to boil out a new unit to remove the grease and dirt left from construction work; also, working data on starting up your air preheater and setting safety valves

By D C SWIFT, *Ebasco Services Incorporated*

► WHEN ERECTION and preliminary inspection are completed (No. 8 of this series, July POWER) your next steps toward getting a new boiler ready for operation are to start air preheater, dry out the brickwork, complete the boilout, set safety valves, and blow out main steam leads. Then kill the fires and slowly cool the boiler.

Starting air preheater. Check for proper location and installation of (1) draft connections and (2) temperature measuring points on inlet and outlet of both air and gas sides of the preheater. Also provide flue-gas sampling lines at preheater inlet and outlet. These lines should give representative samples. Be sure they are tight so proper combustion conditions may be determined.

Provide means of preheater support and make provision for expansion of preheater connecting ductwork. On a regenerative type heater, check alignment of bearings, drive gear and pinion. Lubricate the motor, gear and bearings, and try out the rotation before pronouncing unit ready for initial operation. Make sure connecting ducts and preheater rotor are clean before starting boiler.

An air bypass duct is sometimes provided. Bypassing some air may prevent the leaving flue gas from becoming so cool that it forms moisture and corrodes preheater surfaces. Check dampers in bypass duct and before and after preheater for clearance, tightness, free movement. Damper positions should be plainly marked, convenient platforms, operating levers or chains supplied.

You do not usually have to bypass an air heater if leaving flue gas is above 250 F. But with extremely cold entering air, a fuel with large hydrogen content or considerable sulphur, the safe leaving temperature may be higher.

On tubular preheaters, make frequent checks of metal condition at point of cold-air entry, to establish minimum safe operating conditions for any particular installation.

Tubular preheaters for warming pulverizer air, using steam as a heating medium, do not suffer from corrosion. But they must be warmed up and cut into service slowly to avoid heavy temperature strains in steam-pressure parts. Occasionally listen for steam leakage on the air side of the heater, as a leak causes poor drying of the material being heated by hot air.

On regenerative air heaters you may get excessive wear of circumferential seal strips if you operate much below normal temperature. The rotor assumes an abnormal shape while turning at low temperatures. Usual recommendation is to stop operation when entering flue-gas temperature is below 300 F. This also helps reduce chilling and condensation on cold side of the rotor.

Sometimes rotor is stopped inadvertently at a high boiler rating. When it is started again the extreme variations in rotor temperature cause severe pulsations in air-supply pressure or furnace draft. In this case, turn rotor intermittently, but frequently, a portion of a revolution at a time, until temperatures are evened up. Then resume normal operation.

Accumulations of soot or oil residue on air-heater surfaces sometimes burn. This may cause serious damage, particularly on new installations. To avoid, check completeness of combustion often during dryout, boilout and early operation. Even if preheater does not catch fire, soot coatings increase draft losses, reduce heat transfer, efficiency.

Soot blowers are usually provided for regenerative heaters; they may also be advisable for tubular units under certain conditions.

Insurance, legal requirements. Before starting a fire in a boiler, have a reliable company insure it against explosion or other damage. Ordinarily, inspection and licensing by a state inspector is also required, and boilers operating at 15 psig or above must have at least one properly licensed operator in attendance at all times.

Drying the brickwork and boiler setting is customarily combined with boiling out the boiler and waterwalls. A setting that has air-dried for a month or so will not require much time to dry, while a newly completed setting will contain considerable moisture.

Normal dryout process is this: fill

the boiler to slightly below normal level and add about 25% of the softening chemicals. Leave drum manholes open to keep pressure from building up. Enough fire to bring water temperature up to 150-200 F will dry the setting properly. Time required varies from one to four or more days, depending on size of installation, thickness and quantity of brickwork, amount of previous air drying.

Boiling-out procedure. When setting is reasonably dry, feed the remainder of the chemicals into boiler, close manholes, and gradually increase firing rate. Raise boiler pressure to 20-25% of normal operating pressure over a period of 24 to 36 hr. This higher pressure and rate of heat input causes water and chemicals to circulate in boiler and waterwalls.

Operating with superheater outlet drain valve open or partly open assures against overheating superheater tubes, and also aids boiler circulation. If feed pumps cannot supply water at 20-25% of operating pressure, you may have to limit pressure to slightly below available water-supply pressure.

When boiler has steamed at 20-25% of normal operating pressure for 12 to 24 hr, begin periodic blowdowns from mud drums and waterwalls to remove dirt- and sludge-loaded water. You can also use boiler continuous blowdown lines, and should operate waterwall blowdowns occasionally. Boilout fire is so small that possibility of damage is remote. Never blow down waterwalls in normal operation, however, as circulation may be impaired enough to burn out tubes.

Blow down every 2 to 4 hr for 12 to 24 hr, until samples show water is clearing up and most dirt and sludge has been removed. Restore water level to normal after each blowdown, and if possible add chemicals to maintain initial boilout concentrations.

Fuel for dryout and boilout depends on type and shape of furnace, type of firing equipment, fuel and labor available. Scrap wood, gas or light fuel oil are safe, with proper precautions. Heavy fuel oil and pulverized coal are not recommended.

The dry scrap wood often remaining from construction work can be burned successfully on furnace floor, stoker grates, or temporary grates made of pipes or rails. You need suitable access doors and a considerable amount of labor to feed the fire and maintain steady burning.

Green wood and some resinous dry woods leave a heavy coating of soot or pitch on boiler tubes or air-heater surfaces that may temporarily reduce heat-transfer rates or cause fires in the preheater. Clean dry wood is the safest dryout fuel; and the large amount of radiant heat given off probably dries out the setting more rapidly than other fuels.

Gas is the cleanest, most easily handled fuel for drying and boiling out. It is safe if you install temporary, small stable-flame burners and watch the fire closely. Do not ordinarily try to use the regular gas burners as they are so large that a very low and, hence, unstable flame must be carried.

The alternate of intermittent operation at higher ratings introduces other hazards—frequent lighting off, high heat input to superheater, etc. Assign one man solely to watch the firing. If burners go out, boiler will fill with unburned gas. Thoroughly purge the boiler, or air it out for at least five minutes each time burners are lighted.

You can use No. 2 or 3 fuel oil for dryout-boilout operations. This does not require heating. Already-installed lighting-off torches and burning equipment for this fuel may often be used. Design and operate burners to give a clean, stable flame, and assign one man to watch them. If you do not maintain a clean flame, there is a risk of heavy sooting of heat-transfer surfaces. This may cause air preheater to burn later.

Purge the boiler for at least 5 min before lighting off a burner. Fuel-input capacity of 5 to 7% normal load rate should permit the temporary burners to handle dryout-boilout needs.

Safety valves. Before firing boiler for the first time, check safety-valve flanges. Be sure that (1) blanks used to close drum-nozzle openings for hydrostatic test have been removed (2) flange bolts are tight (3) drains from safety valves, dish ells and low points in vent pipes are complete. If lines have a common drain, a lightweight swing check valve in each line prevents blowback of water around a valve that is not blowing.

Check the vent pipes: Are they firmly supported? Are you sure they will not bear against the valve nozzle when boiler is hot? Have rags and other debris been removed?

Safety valves are usually set at conclusion of boilout, or, sometimes, at blowout of main steam lead and cleanout of boiler. In any case, adjust them as soon as boiler comes up to pressure.

Lift all safety valves by hand at half to two-thirds popping pressure to clean seats and be sure vent pipes will carry off the steam. This operation is safer if you tie a light rope or chain to the operating handle and pop the valve from a distance.

Ordinarily, valve setting equals maximum design pressure. When there is more than one drum safety valve, you can set one at up to 3% above design maximum with the others at intervals of 1 or 2% lower.

Where there is a superheater, provide separate safety valve on the outlet. Set to pop before the drum valves if load is lost suddenly. Steam will then keep the superheater cool until the fires have been cut.

If margin between boiler design pressure and normal superheater-outlet pressure is small: set superheater safety at interval below the lowest drum valve setting, equal to about half the full load-pressure drop through the superheater. Then if load is only partly lost, lowest drum valve will pop first, but superheater will still have steam passing through it. If all load is lost, superheater valve will blow first.

If you have an electrically operated power-control valve, it is usually set at lower pressure than the superheater valve, and will be the first to operate.

Blowback on spring-loaded safety valves should be about 4% of set pressure. If it is much more, you may have to drop pressure below normal to get valves to close. If much less, valve may open and shut intermittently.

Power-control valves usually operate satisfactorily with 1% blowback. If power-control valve's relieving capacity is much over 20% of boiler steaming capacity, you may have difficulty with "hammering" because of pressure surges through the superheater.

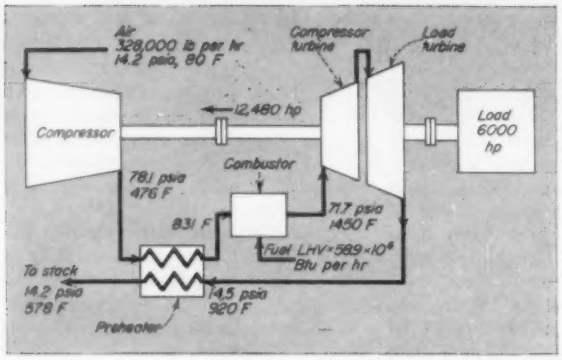
Examine safety-valve mountings carefully, particularly on superheater headers, to see that the reaction from steam escaping will not overstress piping.

You can increase popping pressure by slightly increasing compression of the spring holding disk on the seat. Increase blowback by raising the huddling ring a few notches. Increasing blowback usually reduces popping pressure slightly. Only experienced safety-valve or boiler service engineers should make these adjustments.

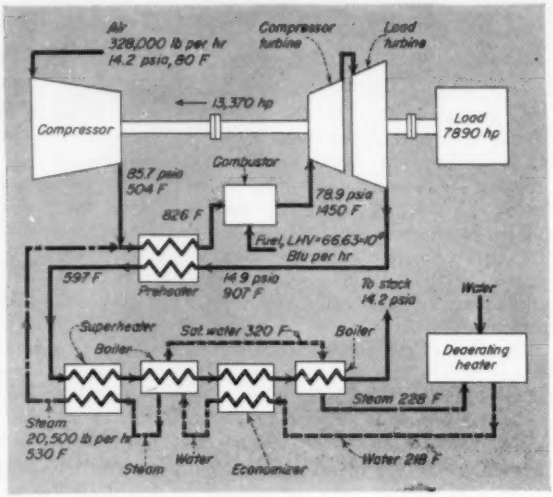
After a spring-loaded valve has popped, let it cool for an hour before trying it again. Valves will pop low by several percent if they are hot.

When setting superheater valves,

(*Continued on page* 184)



1 Energy balance of standard 2-shaft gas-turbine unit is calculated from the data published by the manufacturer



2 Preheater exhausts into duplex waste-heat boiler that generates steam for use in the gas-turbine sections ►

Gas turbines can also use steam!

Benjamin Miller, consulting engineer, analyzes standard gas turbine unit to show how it may use steam to boost both its capacity and its efficiency.* The needed equipment, now under development, seems to be more than economically justified

► BY ADDING STEAM to the air in the gas-turbine cycle both unit installation cost and heat rate can be lowered. Steam-generating equipment applied to existing and new units can raise both capability and thermal efficiency. This assumes that 100% makeup feedwater is bought at reasonable price.

For example, a gas-turbine plant rated 5700 hp at 25% thermal efficiency can have its output increased to 7500 hp at 29% thermal efficiency. The steam-generating equipment would cost considerably less than 20% of the cost of the gas-turbine plant. Less than 50 gpm of water satisfies steam needs.

Conventional plant in Fig. 1 was based on limited published data on the General Electric 5700-hp 2-shaft turbine unit. This heat balance is consistent within itself and is not inconsistent with available manufacturer's data. The author believes these figures are accurate enough to reflect the effect of steam flow.

The manufacturer's rating is 5% less than the 6000 hp shown in Fig. 1. The guaranteed fuel consumption is 4% higher than the author's estimate of 9818 Btu per hphr, lower heating value (lhv). Such margins between estimated performance and what can be prudently guaranteed are not unusually large.

Steam combination. Fig. 2 shows the gas turbine of Fig. 1 with the steam-generating equipment added. Steam mixes with the air at the compressor outlet so they both flow through the preheater (regenerator) on their way to the combustor. The mixture expands in the turbine and flows through the gas side of the regenerator. From here it passes through the superheater, boiler, economizer, low-pressure boiler and finally to stack.

The last four elements could all be placed in a single casing. Many existing waste-heat boilers have economizers and superheaters Two boiler sections operating at different pressures, each with its own steam drum, may easily be arranged in a common casing. This series of equipment, together with water-softening and deaerating equipment, is estimated to cost less than one-fifth of the gas-turbine plant.

Relative Performance. Energy balance in Fig. 2 is based on adding one volume of steam to every 10 volumes of air. Comparing the cycles of Fig. 1 and 2, we can make the following observations.

The nozzle flow area of the compressor turbine is fixed and the nozzle pressure ratio is higher than critical. To make the plant pass as much air as in Fig. 1 when injecting steam, the turbine-inlet pressure must be raised from 71.7 to 78.9 psia.

Pressure drop between compressor discharge and turbine inlet increases proportionally with the mass-flow rate, from 6.4 to 6.8 psi. This raises com-

*Adapted from ASME Paper No. 54-SA-42 presented before semiannual meeting at Pittsburgh, Pa., June 20-24, 1954.

pressor discharge pressure from 78.1 to 85.7 psia. The temperature correspondingly rises from 476 to 504 F and the compressor power from 12,480 to 13,370 hp.

Exhaust-gas pressure drops in passing through the waste-heat boiler and auxiliaries. The pressure drop through the preheater increases because the exhaust flows at higher velocity. The combined effect raises the backpressure on the turbine from 14.5 to 14.9 psia.

Pressure ratio across the two turbines in series increases from 71.7/14.5 = 4.95 to 78.9/14.9 = 5.30, while the flow through them is increased by the 20,500 lb per hr of steam. The increments in pressure ratio and flow raise the available power output of the compressor turbine from 12,480 to 13,370 hp and the net power output of the load turbine from 6000 to 7890 hp.

Sum of the power absorbed in compressing the air and power absorbed by the load is taken in each case as 97% of the turbine enthalpy drop. Three percent of the turbine enthalpy drop is allowed for heat losses from the plant, bearing friction, operation of auxiliary equipment and other miscellaneous losses.

In Fig. 1 temperature drop across the turbine is 530 F and in Fig. 2 it is 13 F more. This change in temperature drop is so small compared to changes in pressure ratio and enthalpy because the heat capacity of steam is much greater than that of air.

Preheater (regenerator) effectiveness is taken as 80% in both Fig. 1 and 2. (This is equivalent to assuming that the changes in pressure composition and velocity of gas streams increase the heat-transfer rate to about the same extent as the increase in pressure drops. While this assumption is not quite correct, the resulting underestimate in fuel consumption is less than 1%.) Air is preheated to 831 F in Fig. 1, while the mixture of air and steam is raised to only 826 F in Fig. 2.

The combustion efficiency of both processes is taken as 98% based on the lower heating value of the fuel. The fuel-flow rate in Fig. 2 is about 13% greater than in the conventional process, but the net power output is about 31% higher.

Comparing Fig. 1 and 2, we see that 6000 hp produced at a heat rate of 9818 Btu per hphr can be raised to 7890 hp produced at 8445 Btu per hphr. Both heat rates are based on the fuel's lower heating value.

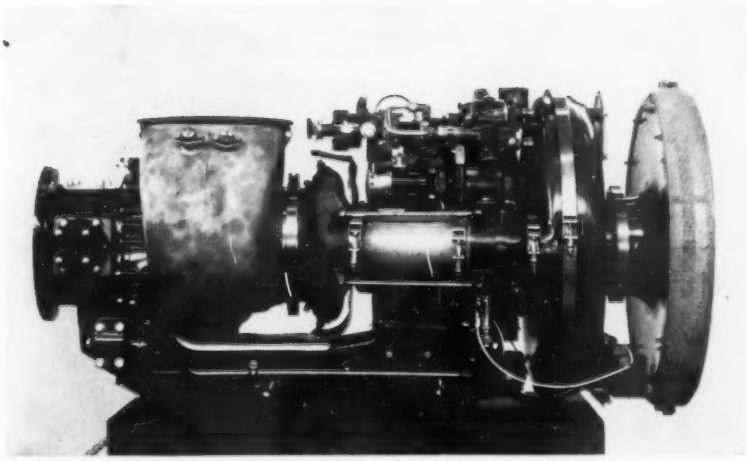
Considering the commercial rating of the GE 2-shaft single-compressor plant as 5700 hp and its guaranteed heat rate as 10,200 Btu per hphr (lhv) at full load, the author feels that when running as in Fig. 2 it will have a 7500-hp rating with a heat rate of 8800 Btu per hphr (lhv).

Ambient temperature at compressor inlet and the load affect performance of the steam-gas cycle to a lesser extent than the conventional cycle. As compressor-inlet temperature increases, the preheater-exhaust-gas temperature increases. This generates more steam, raising the steam:air ratio. This also retards the rate of flow decrease through the turbine with rising compressor-inlet temperature compared to the conventional cycle. On the other hand, falling ambient temperature will not raise capacity and efficiency as much as in the conventional cycle.

As the unit load falls, compressed-air flow decreases and preheater exhaust-gas temperature also falls, so that the decreased enthalpy drops steam generation. Because a greater fraction of the available enthalpy is recovered, however, the steam:air ratio increases. As load falls from full capacity the thermal efficiency rises slightly, reaches a maximum and then drops slowly. Over a considerable load range the thermal efficiency equals that at full load. In the conventional cycle the thermal efficiency falls rapidly with load.

In conclusion, it appears that this combination cycle can be applied with beneficial results to all gas-turbine designs and installations.

Improved design boosts gas-turbine performance

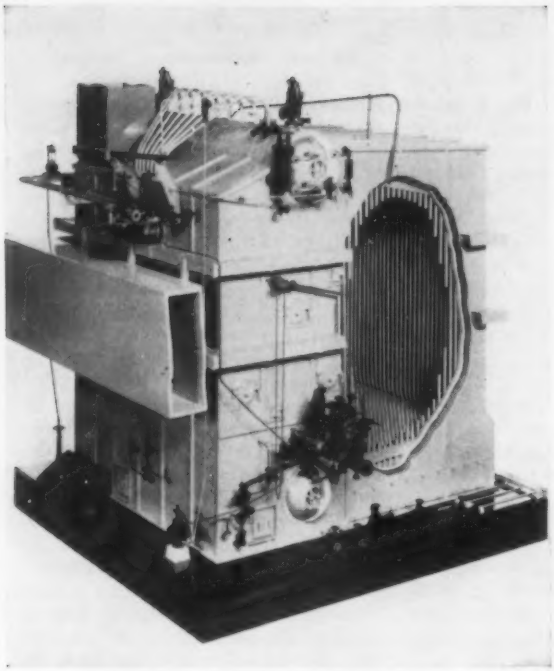


NEW UNIT rated to produce 240 hp at 2900 rpm can develop 270 hp at 3100 rpm. *L to r*, reducing gears, exhaust hood, turbines, combustor, compressor, air intake

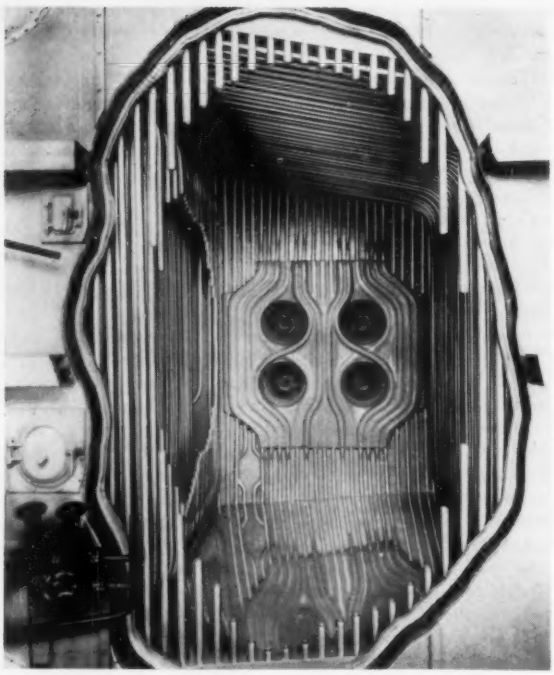
► Boeing Airplane Co just announced an improved form of its small gas-turbine unit, *picture left*. The original model, see *Power*, April 1949, pp 117, 171, has been improved in both compressor and turbine elements to up the rating from 185 to 240 hp. Fuel consumption has been cut by 25%. In addition to component improvements the pressure ratio has been raised.

The new unit weighs 320 lb with all accessories, occupies 15 cu ft. It burns diesel oil, jet fuel or gasoline without modification. The unit has two turbine sections, one driving the centrifugal compressor, the other geared to the load.

Original models have totaled up about 30,000 running hours, including 60,000 miles in a truck, 100 hr in a helicopter, time in a light liaison aircraft. More than 300 of the early models have been built.

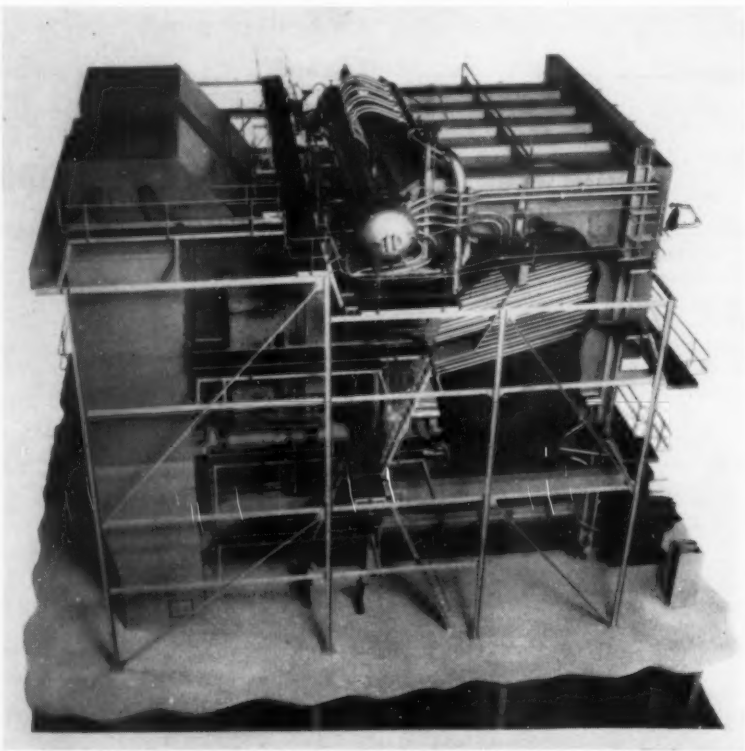


PACKAGE-TYPE BENT-TUBE BOILER built to 1/12th scale shows all parts with great fidelity. Model is 30 in long, 30 in. wide and 27 in. high. Note the minute accessory details



CUTAWAY WALL shows furnace interior of boiler at left, to reveal detail of watercooled walls, burners, refractory facing of burner wall, arrangement of convection-tube section

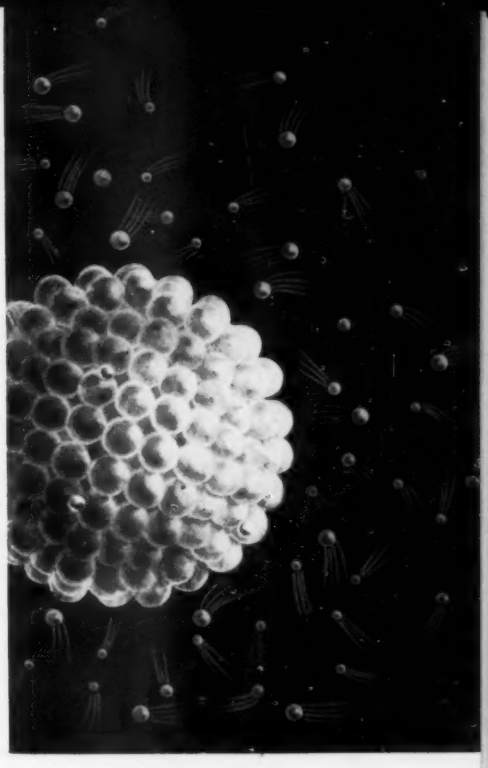
Models help designers, salesmen, buyers and operators



STEAM GENERATOR shows layout of boiler, economizer, air heaters. Mash Engineering Models Ltd of London, England built these models for Babcock & Wilcox, Ltd

NUCLEAR-ENERGY STUDY COURSE: NUMBER 2

How many parts to an atom?



To understand how uranium releases energy we should start by studying what parts make up an atom, how they're arranged, how they behave, how they differ for the various elements

By **HENRY C SCHWENK**, *Henry Pratt Company*
and **ROBERT H SHANNON**, *United Engineers and Constructors, Inc*

► ALL MATERIAL THINGS around us contain one or more of the 100 basic *elements*, or *compounds* of these elements. Compounds are chemical combinations of two or more of these elements. Elements are materials that cannot be decomposed or subdivided into simpler substances by any known chemical means.

The smallest particle of an element is the *atom*, the basic building block of matter. An atom is the smallest ultimate particle into which any element may be divided and still retain its characteristic properties. Each element has its own characteristic atoms, which differ from those of any other element in their internal structure. In the sense that an element retains its identity, its atoms may be regarded as indivisable. If an atom is split into subatomic particles it loses its individuality. The subatomic particles are mostly electrical in nature and do not have the characteristic properties of the element.

The atom has an internal structure consisting of a densely packed nucleus, containing practically the entire mass of the atom, surrounded by electrons continuously moving about the nucleus. The nucleus consists of two kinds of infinitesimally small particles, known as *protons* and *neutrons*, tightly bound together. Each proton carries a single unit positive electrical charge, while the neutrons have no charge. This gives the nucleus a net positive charge.

Balancing each proton positive charge is an electron, orbiting about the nucleus some distance away. The electron carries a single unit negative charge so that the atom as a whole is electrically neutral. We can think of electrons as being arranged in successive layers or shells centered around the nucleus. Shell diameters are very large compared to nucleus diameter, being up to 10,000 times larger than the nucleus. To give an idea of the order of difference, if we scaled up the nucleus to a ½-in.-diameter marble, the outer electron orbits might be 400 ft in diameter. Apparently, then, the atom is primarily empty space. Its mass is concentrated in the nucleus, an electron having a mass equal to only about 1/1840th of a proton mass.

Basic particles. Table I lists the basic particles or components of an atom. The number of protons in the nucleus balances the number of electrons so that the atom as a whole is electrically neutral. The orbital electrons bind the various atoms of the basic elements together into the complex molecules of the thousands of chemical compounds around us.

Electron arrangement in the outermost shells determines the chemical properties of the elements as well as the optical spectra emitted when the atoms are disturbed by absorbing high-temperature energy from a flame or electric arc. Absorption of very large amounts of energy by an atom can disturb electrons in the inner shells and cause X-rays to be produced.

Element designation. An atom may be defined by the number of protons in its nucleus. This value, known as the *atomic number Z*, also represents the number of electrons outside the nucleus of the neutral atom.

Total number of protons and neutrons in the nucleus is called the *mass number A* of the element. Since both the proton and neutron have masses close to unity on the atomic weight scale, it becomes apparent that the mass number of an element is the nearest whole number to the actual atomic weight. The mass of the nucleus is very nearly the entire mass of the atom.

The system of atomic weights is based on the mass of the most predominate atom, oxygen, arbitrarily chosen as 16. Atomic weights are given in atomic mass units (amu) with a mass unit being equal to 1/16th of the weight of one oxygen atom, see Table I.

A = mass number of an element
= number of nucleons
= sum of protons and neutrons in the nucleus
= atomic weight to the nearest whole number

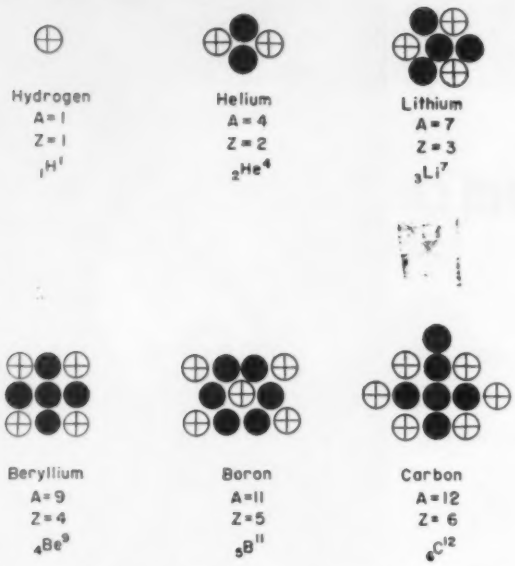
and

Z = atomic number of an element
= number of protons in nucleus
= number of orbital electrons

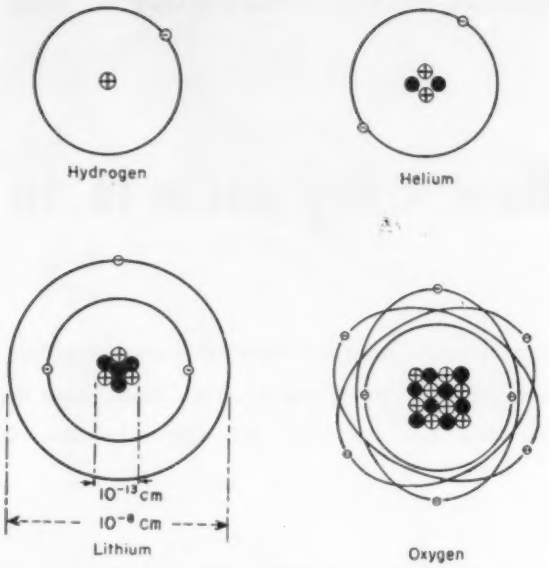
then

A-Z = number of neutrons in the nucleus

When X is the symbol for an element, the method of identifying the element is ${}_{Z}X^{A}$ ($_{Atomic\ No.}$ *Element* $^{Mass\ No.}$).



1 Nuclei of the different elements vary in the number of protons and neutrons they contain. Notation shows makeup



2 Schematics of atoms show number of neutrons, protons and electrons together with the "shells" for electron travel

Table I: Atom components

Particle	Symbol	Nomenclature	Electrical charge	Mass, atomic mass units
Proton*	⊕	$_1p^1$	Single+	1.00758
Neutron*	●	$_0n^1$	None	1.00897
Electron	⊖	$_{-1}e^0$	Single−	0.00054

*Protons and neutrons make up a nucleus, are collectively called nucleons.

Take apart an atom and you'll find protons, neutrons and electrons

Table II: Some typical elements, their isotopes

Element	Atomic number	Mass number	Isotopic weight, amu	Relative abundance, %
Hydrogen	1	1	1.008125	99.98
		2	2.014718	0.02
Boron	5	10	10.01618	18.83
		11	11.01284	81.17
Carbon	6	12	12.00382	98.9
		13	13.00751	1.1
Nitrogen	7	14	14.00751	99.62
		15	15.00489	0.38
Oxygen	8	16	16.00000	99.76
		17	17.00450	0.04
		18	18.00490	0.20
Uranium	92	234	234.12115	0.006
		235	235.12517	0.712
		238	238.13232	99.282

Thus $_2He^4$ designates helium, an atom that has an atomic number of 2 (2 protons in the nucleus) and an atomic weight of 4 (indicating presence of 2 neutrons in the nucleus also). Fig. 1 gives the structure of the nuclei of some of the lighter atoms.

Isotopes. Most elements in nature exist in more than one form, being different in the number of neutrons contained in the nucleus of their atoms. These species of an element are called isotopes of the element. Since the isotopes of an element differ only in the number of neutrons present, then they have the same atomic number but different mass numbers or atomic weights. The atomic number determines the chemical nature of an element. The chemical properties depend on the number of electrons in an atom that equal the number of protons in the nucleus and thus the atomic number. Therefore, the isotopes of an element will be identical chemically, but can exhibit marked differences in nuclear properties.

The designating system distinguishes between the different isotopes of an element since it includes both the atomic number and mass number of the element. Consider uranium, which exists naturally in three isotopic forms of mass numbers 234, 235 and 238. These are designated by $_{92}U^{234}$, $_{92}U^{235}$, and $_{92}U^{238}$ or the shorthand U-234, U-235 and U-238. Because the atomic number (number of protons or electrons) for all three is 92 they are all chemically alike. But the number of neutrons differs, being $A-Z$ = 234–92 = 142 for U-234; 143 for U-235; 146 for U-238.

Isotopes of an element differ widely as far as their abundance in nature is concerned. Table II shows the mass number, isotopic weight (amu) and abundance of some elements of importance. The table shows that 99.282% of natural uranium is U-238, 0.712% is U-235, with minute amounts (0.006%) of U-234 present. The weighted mean of these three isotopic weights of the naturally occurring isotopes gives the atomic weight of the

Table III: Periodic arrangement of the elements

Note: (a) Atomic number stands above name of each element. (b) Symbol and atomic weight stand below name. (c) Figure in parenthesis ( ) indicates mass of most stable isotope known.

Period	Group 0	Group I	Group II	Group III	Group IV	Group V	Group VI	Group VII	Group VIII		
I		1 Hydrogen H 1.0080									
II	2 Helium He 4.003	3 Lithium Li 6.940	4 Beryllium Be 9.013	5 Boron B 10.82	6 Carbon C 12.010	7 Nitrogen N 14.008	8 Oxygen O 16.000	9 Fluorine F 19.00			
III	10 Neon Ne 20.183	11 Sodium Na 22.997	12 Magnesium Mg 24.32	13 Aluminum Al 26.98	14 Silicon Si 28.09	15 Phosphorus P 30.975	16 Sulfur S 32.066	17 Chlorine Cl 35.457			
IV	18 Argon A 39.944	19 Potassium K 39.100 29 Copper Cu 63.54	20 Calcium Ca 40.08 30 Zinc Zn 65.38	21 Scandium Sc 44.96 31 Gallium Ga 69.72	22 Titanium Ti 47.90 32 Germanium Ge 72.60	23 Vanadium V 50.95 33 Arsenic As 74.91	24 Chromium Cr 52.01 34 Selenium Se 78.96	25 Manganese Mn 54.93 35 Bromine Br 79.916	26 Iron Fe 55.85	27 Cobalt Co 58.94	28 Nickel Ni 58.69
V	36 Krypton Kr 83.80	37 Rubidium Rb 85.48 47 Silver Ag 107.88	38 Strontium Sr 87.63 48 Cadmium Cd 112.41	39 Yttrium Yt 88.92 49 Indium In 114.76	40 Zirconium Zr 91.22 50 Tin Sn 118.70	41 Niobium Nb 92.91 51 Antimony Sb 121.76	42 Molybdenum Mo 95.95 52 Tellurium Te 127.61	43 Technetium Tc (99) 53 Iodine I 126.91	44 Ruthenium Ru 101.7	45 Rhodium Rh 102.91	46 Palladium Pd 106.7
VI	54 Xenon Xe 131.3	55 Cesium Cs 132.91 79 Gold Au 197.2	56 Barium Ba 137.36 80 Mercury Hg 200.61	57-71 Lanthanide rare earths 81 Thallium Tl 204.39	72 Hafnium Hf 178.6 82 Lead Pb 207.21	73 Tantalum Ta 180.88 83 Bismuth Bi 209.00	74 Tungsten W 183.92 84 Polonium Po 210	75 Rhenium Re 186.31 85 Astatine At ( )	76 Osmium Os 190.2	77 Iridium Ir 193.1	78 Platinum Pt 195.23
VII	86 Radon Rn 222	87 Francium Fr 223	88 Radium Ra 226.05	89 Actinium Ac 227	90 Thorium Th 232.12	91 Protactinium Pa 231	92 Uranium U 238.07	Trans-uranium elements			

Rare earths—lanthanide and actinide series

Lanthanide series	57 Lanthanum La 138.92	58 Cerium Ce 140.13	59 Praseodymium Pr 140.92	60 Neodymium Nd 144.27	61 Promethium Pm (145)	62 Samarium Sa 150.43	63 Europium Eu 152.0	64 Gadolinium Gd 156.9	
	65 Terbium Tb 159.2	66 Dysprosium Dy 162.45	67 Holmium Ho 164.94	68 Erbium Er 167.2	69 Thulium Tm 169.4	70 Ytterbium Yb 173.04	71 Lutecium Lu 174.99		
Actinide series	89 Actinium Ac 227	90 Thorium Th 232.12	91 Protactinium Pa 231	92 Uranium U 238.07	93 Neptunium Np (237)	94 Plutonium Pu (242)	95 Americium Am (243)	96 Curium Cm (243)	97 Berkelium Bk (245)	98 Californium Cf (244)

element as a whole; for uranium it is 238.07. This explains why the atomic weights of some elements are not approximately integral values. With the nucleus consisting of both protons and neutrons, both of which have masses near unity, one would expect that the atomic weights of all elements would be very close to unity. With many elements this is the case. The exceptions are caused by the presence of larger percentages of naturally occurring isotopes of different atomic weights so that the average is not a whole number.

Only 21 of the elements exist naturally as a single species, the remainder occurring as a mixture of isotopes. Over 300 isotopes have been found to occur naturally. In addition, over 700 other isotopes have in recent years been artificially produced by various nuclear reactions. As a result the 100 known elements have been identified in over 1000 forms.

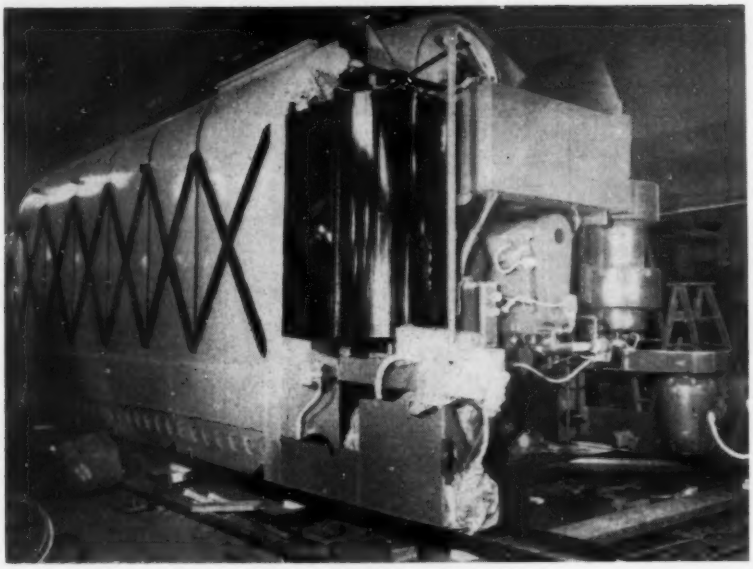
Fig. 2 shows how some of the lighter elements might be diagrammed. These are more symbolic than real and should not be taken too literally. The actual state of affairs within the atom—the relative sizes and distances involved and actual form of the atom—are difficult to represent on paper.

The Periodic Table systematically arranges the elements according to their atomic numbers, see Table III. Properties of the elements seem to vary periodically with their atomic weights.

We know that the electrons determine the chemical properties of the elements and that the regular repetition of properties at definite intervals is caused by common electron arrangement in the outer orbits. The elements are arranged in Periods and Groups. Order of the elements in each series corresponds to increasing atomic weights, and with this coincides gradual variation of the physical and chemical properties of the elements. The groups denote the periodical recurrence of elements possessing similar properties.

The next installment will deal with radioactivity and its relation to nuclear energy—in a forthcoming issue.

By G E DeSIENA, *President*
Superior Combustion Industries, Inc



BOILER IN SHOP being readied for shipment. On either side are induced-draft fans and motors. Flue-gas duct goes off to side above burner assembly, controls

How Navy installed 3-fuel watertube units of

► SIX WATERTUBE BOILERS furnish steam for the Navy steel-cartridge-case manufacturing plant at Louisville, Kentucky. These units fire oil, gas or coal.

With the exception of the stokers, these boilers were completely fabricated and assembled in the boiler shop before shipping. The assembled package included gas-and-oil burner with motor, induced-draft fans with motors, auxiliary-blower motor, and control panel. Each unit was shop-tested before shipping.

Pictures show sequence from shop to plant and the mounting of the boilers on previously erected structural-steel supports. This steel serves the additional purpose of supporting the grates. Brickwork was completed after boilers were mounted.

Requirements.. Units were designed to generate 34,000 lb per hr of steam at the maximum operating rate, using any of the three fuels. Design pressure is 160 psig, operating pressure 125 psig. Steam is 350 F saturated, and required quality at maximum rate is 98%. Feedwater temperature for design was 212 F; maximum permissible solids in boiler water, 3500 ppm.

Coal was to be the primary fuel, with oil and gas as standby fuels.

Description. Boiler is 3-drum unit with furnace depth from front to rear wall about 20 ft. Grate, installed at front part of unit, has a nominal length of 11½ ft. Structural-steel supports mentioned above extend seven feet above pier foundations, and the boiler rests on these supports. Grate level is four feet below this.

Furnace walls are completely water-cooled down to water drums, leaving refractory walls in coal-burning area below the water drums. Tubes serving as side waterwalls have a complete refractory baffle behind them, extending all the way from the front wall to within about two feet of the rear wall, and from water drum to steam drum. Area at rear of furnace has nine rows of staggered tubes. At the third row a refractory baffle extends from the furnace floor to roughly three feet above the floor (center line distance between water and steam drums is nine feet) and extends out in width to the sidewall baffles. These three baffles join at their extremities.

Main portion of the generating bank is in the area between sidewall baffle and side casing. Partial baffles arranged in this area, from steam drum down and from water drum up, direct the combustion gas for better "scrubbing" action.

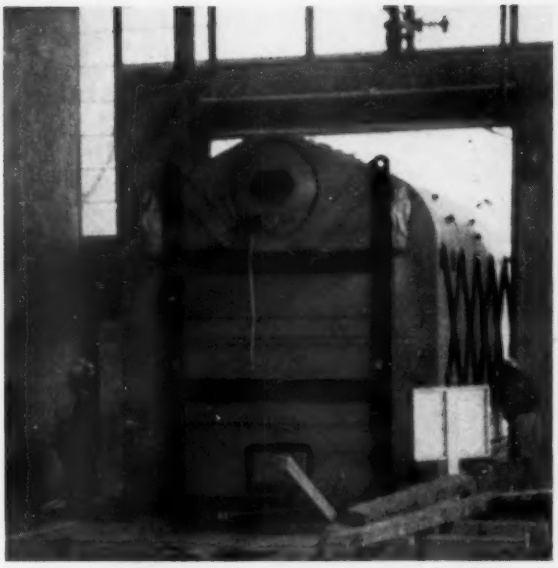
Path of combustion gas is from furnace through widely spaced tubes at rear and then toward the boiler front through the main generating banks on either side. Two induced-draft fans draw the combustion gas. From these, gas goes to the precipitator and out the stack via the precipitator fan.

Furnace volume is 1290 cu ft, boiler heating surface 4000 sq ft. Wet weight of each unit, including stoker and auxiliaries, is about 106,000 lb.

Oil and gas firing. There is one rotary-cup oil burner per boiler. Burners have modulated control giving a firing range from 8500 to 34,000 lb per hr of steam. Burner fan, oil pump and rotary cup are driven by single 7½-hp motor. Burner is equipped to burn gas with an auxiliary gas ring. To burn oil or gas, grates and stoker front must be bricked over. Changeover from oil to gas, or vice versa, may be made in two to three minutes.

Bunker-C fuel oil is stored in under-

ON FLAT CAR for shipping. Note strengtheners on side of the casing. No difficulty was experienced in moving the boilers



AT CASING PLANT. Boiler is being rolled in. Stoker for this unit will come in another shipment. Building is boiler room

packaged type

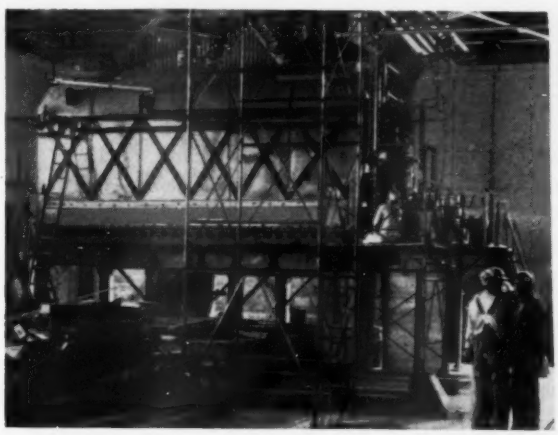
ground reinforced concrete tanks. Oil is drawn through steam-heated suction heaters and circulated to the boilers. A 5-kw electric oil heater is mounted on the burner assembly.

Oil-gas controls. Controls were originally mounted on control board of each boiler. Controls have since been moved to a main control board.

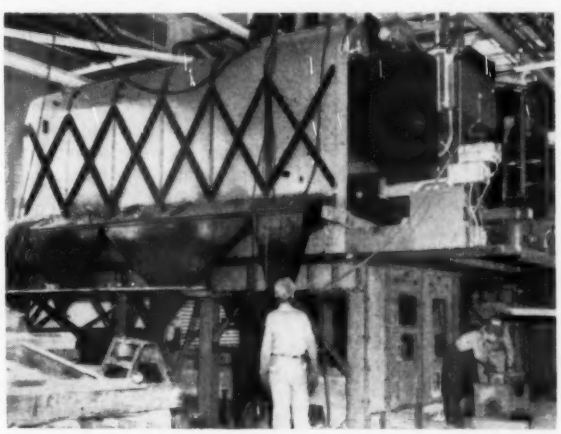
There is an automatic light-off cycle. Automatic control provides a 5-minute purge period with the stack damper wide open. At the end of the purge, the damper closes to a minimum opening position and pilot lights. Burner starts on low fire and automatically goes to high fire until operating pressure is reached. Burner then modulates automatically to maintain pressure.

Units are furnished with following safety controls for oil and gas:

1. When steam pressure goes above a designated setting due to drop in steam demand, burner goes off, automatically relighting when pressure drops.
2. With low water, the burner goes off. When water level is restored, boiler comes back in automatic operation. (Pilot light is on continuously).
3. On high water, an alarm sounds



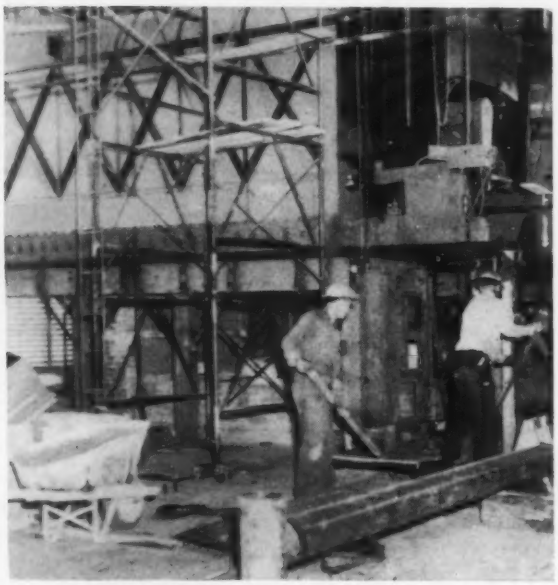
FIRST BOILER IN PLACE on its structural-steel supports. These had been erected before the installation of boiler



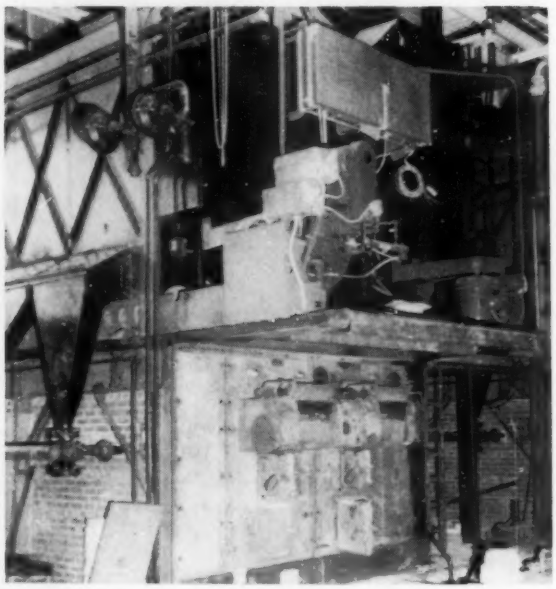
THREE BOILERS IN PLACE. The dust-collector hoppers can be seen on the side of near boiler. Stoker front is being set up

From oil or gas to spreader stoker firing . . .

In only a matter of a day or so



BACK BRICK WALL is shown, installed in this unit. A general idea of stoker to furnace depth can be had from this view



STOKER FRONT and brickwork complete. Note piping arrangement for the dust-collecting system. One pipe goes to furnace

and the boiler continues in operation.

4. For flame failure, everything, including the pilot light, goes off. To restart, all procedures, including purge period, must be gone through.

5. On failure of induced-draft fans, the burner goes off. When fans are back in service, the boiler automatically comes back in operation.

6. With failure of burner fan, same as 5, above.

Coal firing. Two overthrow rotors spread the coal over the stationary, 2-section hand-dumping grates.

To fire on coal, the gas-oil burner opening is bricked up and feed hoppers attached to front of unit. These hoppers hold about 3000 lb of coal. Brick covering on the grates must be removed. The complete changeover time is about eight to 12 hours.

Air for coal burning is furnished through the grates by an undergrate steam-turbine-driven blower. Steam jets are installed in the walls above the grates to aid in coal combustion.

Coal is stored in the open and dragged to a conveyor and crusher with a drag scraper operated from a stationary winch. From the crusher the coal is elevated to a storage bin. A lorry takes the coal from this bin and feeds it to the hoppers mounted on the boiler.

Ashes are hand raked to a trough in front of the furnace firebox. A vacuum system picks up the ashes from the trough and sends them to an elevated silo. Here they are loaded directly into railroad cars and hauled away.

Cinder-collection hoppers, see pictures, are arranged around the boiler. These hoppers go into lines radiating out from the furnace, the lines finally joining into a common collecting line. An injection fan keeps the dust moving and sends it back to the furnace. Much of the unburned carbon is reclaimed in this manner. The system works automatically — continuously during coal operation.

Coal controls. Spreader-stoker feed and forced-draft fan are controlled by regulator responding to steam pressure in the main-steam header. Uniform furnace pressure is maintained by another regulator actuating stack damper.

Safety controls are: (1) high steam pressure (2) low water (3) alarm only for high water (4) failure of induced-draft fans.

Auxiliaries. Each unit has two 20-hp induced-draft fans mounted on the front of the boiler. Discharge from these two fans combines and goes to a precipitator. Between precipitator and stack there is an additional 30-hp exhaust fan to overcome resistance of the precipitator. The latter fan, mounted over the boiler, is fitted with a fan for cooling the bearings.

Additional electrical load of boiler auxiliaries: 1½-hp motor for the cinder-injection fan; ¾-hp motor for the stoker; 7½-hp burner motor; 5-kw oil heater. Also, a ¾-hp spare blower motor is mounted at front of unit.

On actual test, the boilers gave better than anticipated performance. Efficiencies for oil and coal firing were very close to 80%. Efficiency for gas firing was better than 81%. All efficiencies are at the maximum operating rate. Steam quality was 99.2% at the maximum rate of operation.

How to size air-removal system for surface condensers

► GETTING TOP EFFICIENCY from surface condensers depends to a large extent on the vacuum we maintain in the condenser. Accepting the fact that no turbine-condenser system is 100% air leakproof and that air and other noncondensable gases will tend to build up condenser pressure, we provide air-removal equipment of sufficient capacity to maintain the necessary high vacuum at the turbine exhaust.

First step in sizing our air-removal system is to estimate the amount of leakage expected. For this purpose the Heat Exchange Institute has compiled table I, right, based on many years of experience with steam surface condensers. Although these are minimum safe figures for sizing vacuum pumps, a tight system can be expected to show even better performance.

Because the air pump must handle not only dry air, but also the water vapor with which it is saturated, we must figure the weight of water vapor per pound of free dry air. Following formula does the job:

$$W = 0.62 \frac{P_w}{P_t - P_w}$$

Where

W = pounds of water vapor per pound of free air at standard conditions of pressure and temperature.

P_t = absolute pressure in inches of mercury of the air-vapor mixture. For calculating purposes we use same pressure as at steam inlet to the condenser—*but* with this limitation: For condensers serving turbines this pressure is taken as 1.0-in. Hg or actual pressure, whichever is lower. For condensers serving steam engines this pressure is taken as 3.5-in. Hg or actual pressure, whichever is lower.

P_w = partial pressure of water vapor in the mixture, inches of mercury. To get this figure: (1) Find saturation temperature corresponding to P_t from steam tables and subtract 7.5 F from it. (2) For P_w use saturation pressure corresponding to this reduced temperature.

To get total weight of water vapor, convert free atmospheric air leakage, table I, from scfm to lb per hr:

Free air leakage, lb per hr = figure from table I × 60 × .075. (Atmospheric air density at 70 F is .075.) Multiply this result by W to get total weight of water vapor in lb per hr.

Now let's work a typical problem to see how we put this information to use in sizing an air-removal system.

Problem: A surface condenser serving a turbine is designed to operate at 1.0-in. Hg with a condensing load of 75,000 lb per hr. Find the necessary capacity of the air removal system.

Solution: 1. P_t = 1.0-in. Hg. Saturation temperature corresponding to this pressure is 79 F. (From steam tables.)

2. 79 F − 7.5 F = 71.5 F. P_w is the saturation pressure corresponding to this temperature. P_w = 0.78-in. Hg.

3. Apply formula for W to figure water vapor.

$$W = 0.62 \frac{P_w}{P_t - P_w} = 0.62 \frac{0.78}{1.0 - 0.78} = 2.20$$

4. Entering table I at 50,001 to 100,000, we select 5.0 scfm for dry air capacity. Convert this to lb per hr.

5.0 scfm × 60 × 0.075 lb per ft³ = 22.5 lb per hr, dry air.

5. Find total weight of water vapor.

2.20 lb water vapor per lb dry air × 22.5 = 49.5 lb per hr, water vapor.

Rapid evacuators are used for reducing pressure in the steam space of the condenser when starting the turbine. Table II gives capacities required.

—HOWARD KALLEN, *Assistant Editor*

TABLE I
***VACUUM PUMP CAPACITIES**

Maximum steam condensed, lb per hr	Dry air, scfm: Serving turbines	Dry air, scfm: Serving engines
Up to 25,000	3.0	6.0
25,001 to 50,000	4.0	8.0
50,001 to 100,000	5.0	10.0
100,001 to 250,000	7.5	15.0
250,001 to 500,000	10.0	—
500,001 and up	12.5	—

TABLE II
***RAPID EVACUATOR CAPACITIES**

Maximum steam condensed, lb per hr	Dry air, cfm at 70 F, 15-in. Hg absolute
Up to 75,000	150
75,001 to 250,000	300
250,001 to 600,000	600
600,001 and up	900

**Standards of Heat Exchange Institute, Steam Surface Condensers, Third Edition*

© POWER

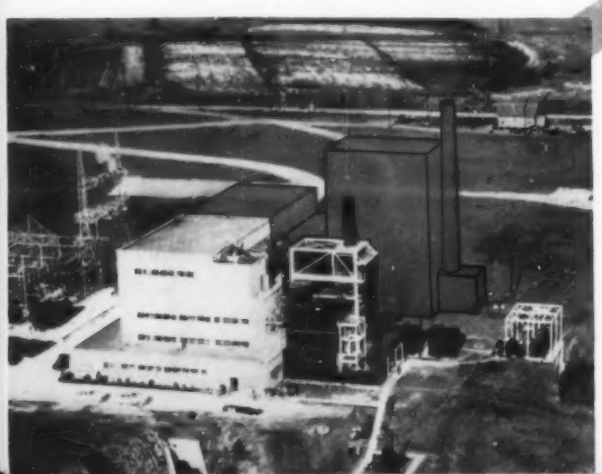
Now... reheat

small, compact 350,000 lbs./hr. RILEY reheat unit will power a 50,000 kw. turbine

In recent years, many public utility companies purchased *reheat steam generating units* for highest practical economy of power production, but most of them were designed for large turbines with rating of 75,000 kw. and more.

Central Louisiana Electric Company, Inc., after thorough consideration and study of economic factors, concluded that extra capital expenditure for reheat was warranted for new steam generating facilities at its Teche Power Station, Baldwin, Louisiana.

This small, compact 350,000 lbs./hr. Riley reheat steam generating unit will provide steam for a reheat turbine of 50,000 kw. nominal rating. The design is the result of close cooperation of engineers of Central Louisiana Electric Company, Sargent and Lundy and Riley.



If you are considering meeting relatively moderate power demands with a medium sized steam generating unit, it will possibly pay you to consider the advantages offered by this small reheat design. With the addition of Riley's exclusive single header hopper bottom this basic design can be readily adapted to pulverized coal firing.

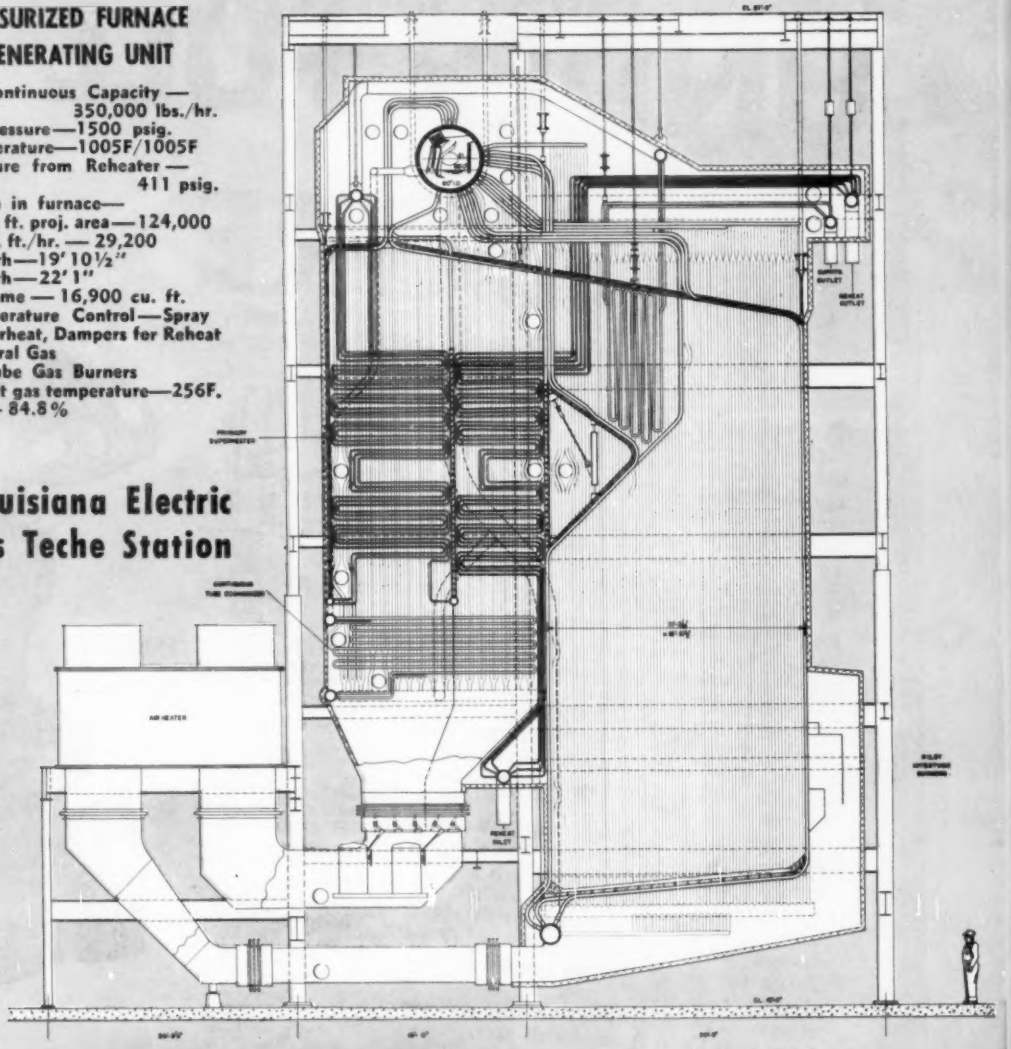
A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

for the smaller steam turbine!

RILEY PRESSURIZED FURNACE STEAM GENERATING UNIT

Maximum Continuous Capacity — 350,000 lbs./hr.
Operating Pressure—1500 psig.
Steam Temperature—1005F/1005F
Steam Pressure from Reheater — 411 psig.
Heat Release in furnace—
btu./sq. ft. proj. area—124,000
btu./cu. ft./hr. — 29,200
Furnace width—19' 10½"
Furnace depth—22' 1"
Furnace volume — 16,900 cu. ft.
Steam Temperature Control—Spray for Superheat, Dampers for Reheat
Fuel—Natural Gas
Riley Intertube Gas Burners
Airheater exit gas temperature—256F.
Efficiency — 84.8%

at **Central Louisiana Electric Company's Teche Station**



SARGENT & LUNDY, Consulting Engineers

RILEY *Stoker Corporation*

WORCESTER, MASSACHUSETTS

Boston New York Philadelphia Buffalo Washington Pittsburgh Cleveland Detroit Chicago Cincinnati Charlotte New Orleans
Atlanta St. Louis Kansas City St. Paul Tulsa Houston Denver Salt Lake City Los Angeles San Francisco Portland Seattle

COMPLETE STEAM GENERATING UNITS

AND FUEL BURNING EQUIPMENT FOR PUBLIC UTILITIES, INDUSTRIAL POWER AND HEATING PLANTS

MAINTENANCE MEN PREFER
O-B VALVES BECAUSE . . .

they can be repacked UNDER FULL PRESSURE

● Packing in O-B valves, even when they are installed on live steam lines, can be replaced without shutting down the lines. Maintenance becomes easier, and quicker--since costly interruptions of production and service can be avoided.

With an O-B globe valve fully open, the bevelled collar on the stem seals tightly against the bottom of the center piece. O-B gate valves also can repacked under full pressure.

Further simplifying the maintenance of O-B valves is the long life of the high grade split ring Jewett-type packing used. It has greater body than ordinary asbestos and graphite packing and lasts longer.

Good packing which can be easily replaced when necessary is one of many features that have brought O-B bronze valves into the maintenance man's favor. They're available in sizes up to three inches, for up to 200 pounds working steam pressure--also with ends for soldering and with rising or non-rising stems. The complete line is available from your Ohio Brass distributor.

Ohio Brass Company
Mansfield, Ohio

Stem is bevelled to seal against chamfer on bottom of centerpiece, when valve is fully open. Pressure is contained within valve body during packing.

Ohio Brass Valves

BRONZE GLOBES, ANGLES, GATES AND CHECKS FOR
INDUSTRIAL AND DOMESTIC SERVICE

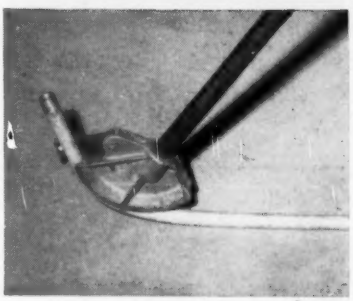
4444-V

Have your plant electricians follow this step-by-step guide when...

Working with aluminum

▶**Welding is one method used for joining aluminum conductors and terminals; practical where many terminals needed in one area. Joints can be made with aluminum-solder, flux**

▶**Bolted connectors are well suited for hard-to-get at spots. Rub a joint compound on both conductor and connector before makeup. Compression connectors are quickly installed with manual or hydraulic tools.**



▶**Aluminum conduit is worked much like steel. Corrosion-resistant, nonmagnetic properties fit limited needs not met with steel. The lightweight feature cuts labor**

Here are the on-the-job steps that simplify installation of aluminum conductors and conduit. Keep in mind there are basic differences between copper and aluminum. Size is one. Copper has higher conductivity; aluminum is 61% as conductive for a given wire diameter. That's why larger aluminum wire and conduit is generally needed. For overhead installation of large conductors, lighter weight per amp is significant. The fact that a larger diameter conductor is needed proves of secondary importance on open runs: See pp 84-87. *Photos by the Aluminum Company of America.*

Turn page ⟶

Rugged, simple connections through welding

On a big industrial job where many terminations must be made in one location, the inert-gas welding technique with aluminum terminals is fast and efficient. No flux is required; weld is clean, and of high conductivity.

Arc welding is suited for joints up to about No. 8. A dc arc gives the best operating characteristics. You can use 8 standard 6-v storage batteries as the power source. Batteries are connected in series and tapped at different locations to provide a selection of 24 to 48 v. Other dc sources are OK provided the arc voltage does not drop below 20.

Hand electrode consists of a replacement graphite button in a small holder. Pliers or similar gripping rig makes up the ground assembly. Both hand-electrode and pliers connect to power source through flexible leads. Use an arc shield around the electrode to protect operator's eyes.

No surface preparation is needed other than removal of insulation. Weld is made by simply striking an arc between wire and carbon electrode. No flux or protective atmosphere is necessary. Negative side of power source connects to carbon electrode.

There are some applications where aluminum must be joined to other metals; copper is an example. Inherently the alloying of copper and aluminum results in a brittle combination that must be protected mechanically. Joint is more ductile when the percentage of copper is under 20%. An aluminum sleeve or wire wrap may be used when making an aluminum-copper joint, thereby providing an excess of aluminum in the weld bead.

Aluminum solder with conventional heating methods is also used for making joints. Whether torch, iron or dip method is used, basic ingredients are flux and solder designed for aluminum. Molten aluminum solder flows evenly into strands at normal soldering temperatures.

1 Slit insulation back enough to protect it against welding heat. Turn knife blade out to avoid nicking cable strands

4 Finished terminal has a fused end. Replace insulation and tape over terminal socket. Inspection made from weld face

7 Branch circuit wiring may also be welded. First twist about six turns; then wrap an additional wire for extra strength

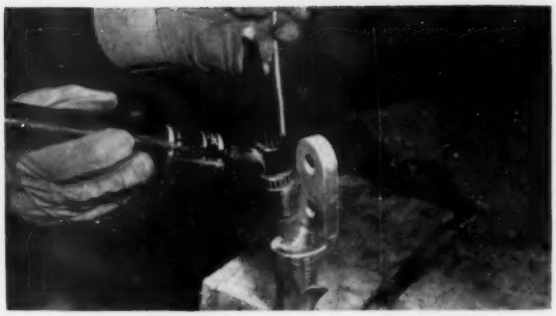
Compression connectors prove big timesaver

For 40 years compression fittings have been used to join electrical conductors, primarily on aluminum aerial transmission lines. Now similar fittings are available on insulated wire and cable (POWER, July 1953, pp 116-119). They are applied to the conductor with tools that exert enormous pressures, compressing barrel of the terminal around conductor or forming a deep indent.

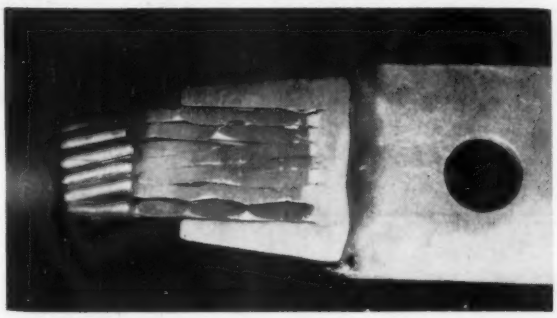
Cross sections of compression joints show the cable strands and barrel of fitting compacted into practically a solid mass. Wiping action of metal surfaces during compression breaks oxide film, giving low electrical resistance.

PREPARE WIRE for a compression terminal by first stripping off the insulation, much as you would whittle a pencil end

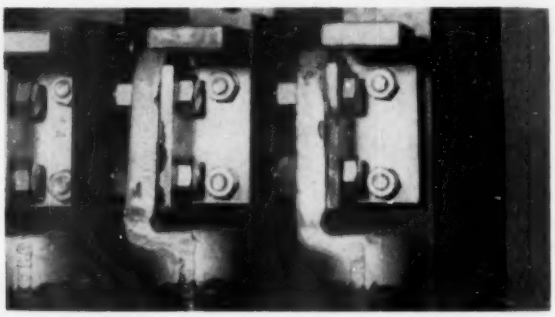
2 Tie back insulation before welding and slip terminal over cable end. Clamp lead from welding-set right on conductor



3 Strike arc in normal manner, concentrating on cable end. Form a weld pool in terminal by adding metal from filler

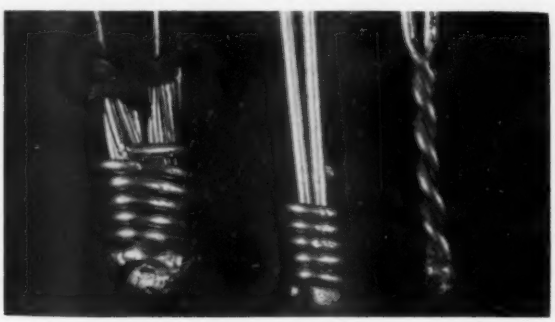


5 Cutaway of terminal after welding shows metal flow pattern within the fitting and metallurgical bond at weld point



6 Installation of both welded and compression fittings made after applying joint compound. Note the large contact areas

8 Grasp joint with electrode pliers just above the insulation. Strike arc by making contact between wire, carbon electrode



9 Typical joints made by welding. Joint, *right*, strengthened by adding wire wrap or compression sleeve prior to welding

SLIP cable end in barrel of compression terminal after applying joint compound

DROP TERMINAL in portable hydraulic tool, crimp by applying hand pressure

CRIMPED terminal boasts a lower joint resistance than equivalent wire length

CONTINUED ON NEXT PAGE

Bolted connectors installed with hand wrench

A wide range of electrical connectors is available for use with aluminum. Bolted fittings are chosen because of their speed in setting up and their over-all simplicity, requiring few installation tools. Connectors of this type should have ample contact area. Connector body and bolts must be rugged enough to exert the high pressures required. A well-designed and properly applied bolted connector distributes the applied force evenly to give a highly conductive electrical connection.

Dependable joints are important from a safety angle, too. A tight low-resistance connection is a cool one that won't overheat. Actually, one made with top-quality modern connector will run cooler than the conductor itself.

Keep in mind that dependable electrical power in modern industrial-plant distribution systems hinges on many factors: reliable power source, trouble-free substations, transformers, switchgear and electrical connectors.

1 Parallel groove connector installation started by skinning insulation. Whittle but don't "ring" for fear of nicking

3 Coat conductor with compound, repeat abrasive treatment. Quite often compound is applied with an abrasive dauber

Small wires need compound tool!

Installation of aluminum branch circuit wiring differs somewhat from copper. But as with copper the insulation must be skinned, a loop made and the wire slipped under a terminal screw. However, since aluminum wire is always larger in diameter than copper of comparable current-carrying capacity, the terminal screw must be large enough to accommodate. As with all bolted and compression connections, a joint compound must be used.

LOOP TERMINAL for small wires is begun by carefully trimming off the insulation

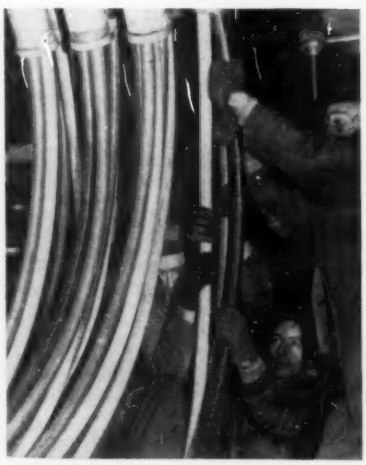
FORM LOOP with pair of round-nose pliers. Take care aluminum is never nicked

Tips on using aluminum conduit

Aluminum conduit poses a number of apparent advantages over steel, but at a higher first cost. It's lighter, corrosion resistant and easy to install. Installation of aluminum conduit is quite similar to that of steel, as outlined to right.

Major advantage on most jobs is its weight. Higher first cost can be trimmed somewhat by labor savings during installation. This lightweight feature shows a cost saving in general handling and trucking also, even before the conduit reaches the site.

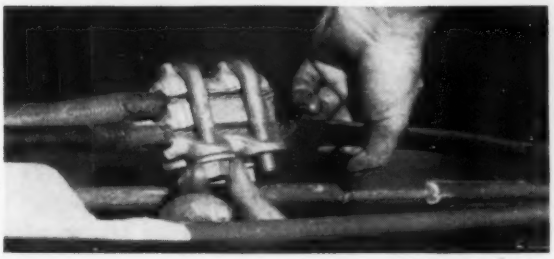
Another thought to consider is its nonmagnetic properties. There are some spots in many major setups where the job would be easier if the legs of a feeder could be isolated into three runs.



LIGHTWEIGHT aluminum conduit, conductors, team up to trim installation costs

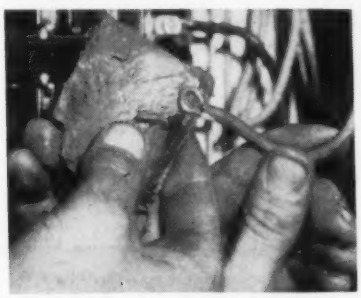
HAND TOOLS used to cut and ream aluminum same as for heavier conduits

2 Coat connector grooves with compound, then rub conducting surfaces with an abrasive cloth *right through the compound*

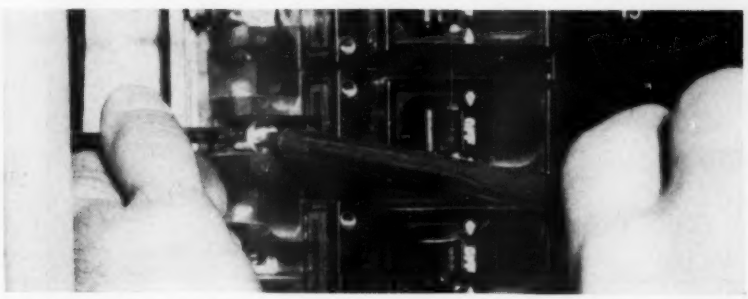


4 After clamp is positioned, tighten connector nuts by hand, carefully adjusting wire and grooves for proper contact

5 Here is final step before insulating. Check that all bolts are tightened evenly to insure right pressure distribution



COAT LOOP with joint compound; rub in with abrasive cloth to break oxide film



TURN WIRE LOOP clockwise as with all types wiring. Before slipping loop under terminal screw, coat both the screw and flat contact surface with joint compound

CUT THREADS in aluminum with dies having greater rake angle for chip clearance

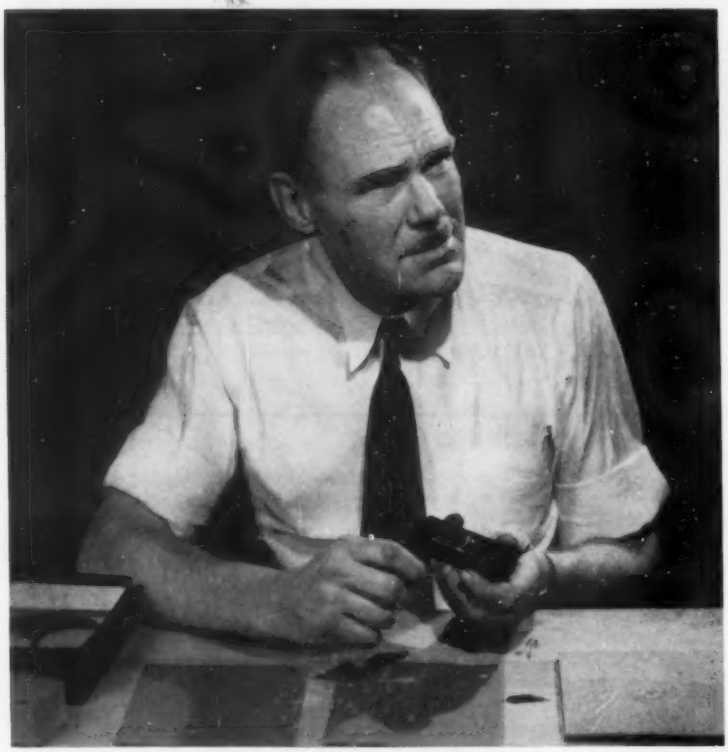
MAKEUP STEPS remain same as for steel. Use standard pipe compound at all joints

BENDING of lightweight aluminum is lots easier, and less costly, than steel type

OPERATORS' NOTEBOOK 77

This handy gasket cutter

By STEVE ELONKA, *Associate Editor*



GETTING READY, Jack Cave selects pointed blade to cut a small circular gasket

Round or odd shape - tool cuts it

► MICROMETERS, dial indicators, feeler gages, etc, have been the mechanic's everyday tools for years. Now it looks as if this handy gasket cutter has earned the right to join the family, to be in every mechanic's tool box. It is strictly a manually operated tool and combines features of the circle cutter, straightedge, compass, scorer and knife.

Made of phenolic, it has both inch and metric scales. It cuts precision round-gaskets, washers and disks from ¼ to 6 in. Cuts any size odd shape and straight strips and shims.

Larger-size gaskets are cut with a second model, made of aluminum, with extensions enabling you to cut up to 60-in. diameters.

Materials cut are aluminum foil, asbestos, chipboard, cloth, hycar, linoleum, mica, neoprene, plastic, sandpaper, saran, silicone, rubber, wallboard, leather, wool, vegetable fiber, cellophane, etc.

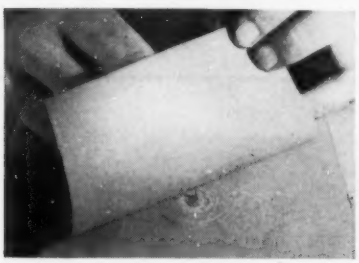
Exclusive feature: Cutter-head slides over thinnest material with an ironing or pressing action while cutting. This prevents buckling or crinkling, permits accurate cutting. Because of ironing action, one hand only is needed to guide cutter. This leaves other hand to hold gasket material, although that isn't always necessary because of friction between cutting board and material being cut.

With trend toward narrow gaskets of various shapes, for higher and higher pressures, gaskets must be made right. Labor costs and outage caused by leaky joint are a big item, not gasket material or cutter. That means it's just as important to stop leak the first time as to use the right gasket material.

Photos taken at Zimmerman Packing Company, Cincinnati Ohio

Small round gasket

1 Insert this blade for circular cuts and extend it through the other side



5 Remove post from cutter body, insert into the gromet of the cutting board

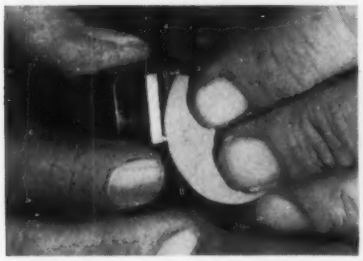
Irregular shapes

1 Insert the curved blade for odd shape after cutting round diameters first

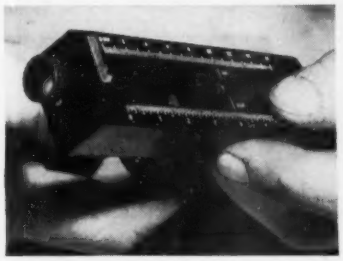
Large round gasket

1 Attach arms needed to set for larger diameter that small cutter won't do

does better work, saves money

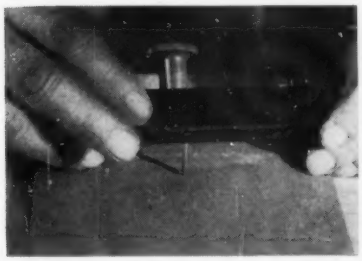


2 Adjust tiny point of blade to extend a bit deeper than material thickness



3 Set diameter of first cut on direct reading scale in either inches or mm

4 Place pivot post in cutter-body end, insert through center of the material

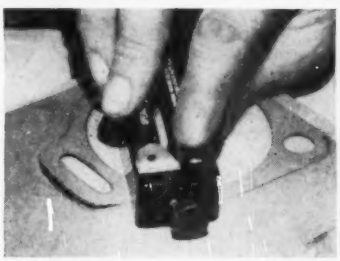


6 Place the cutter body over pivot post and force blade through the material

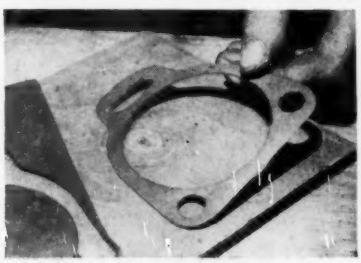
7 Rotate body about post. Adjust for inside cut and guide around as here

8 Reset cutter for bolt diam, use bolt circle scribed lightly with blade

2 Inch cutter body along, with tracing index-line following the drawn line



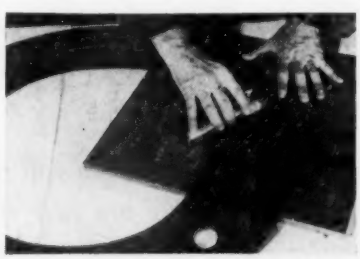
3 Continue irregularly shaped cut by pulling the cutter body along the line



4 Completed gasket is ready to install. Scrap can be used for smaller gaskets

2 Center material and cut gasket same as you did with the 6-in. diam cutter

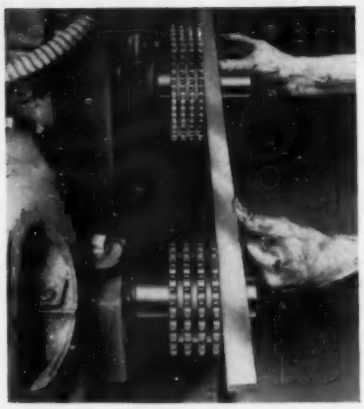
3 Reset cutter for inside diameter by using fewer arms and cut material



4 Scribe bolt circle with cutter, then reset for bolt dia and cut them out

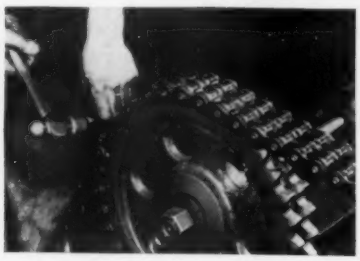
Installing

Align the shafts. (1) Check levelness at sprockets (2) measure distances between shafts to ensure that they are parallel

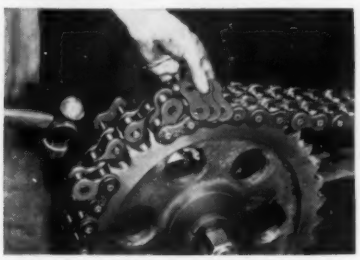


Align sprockets axially on the shafts. Check with a straightedge or stretched wire run along sprockets' finished sides

Cutting

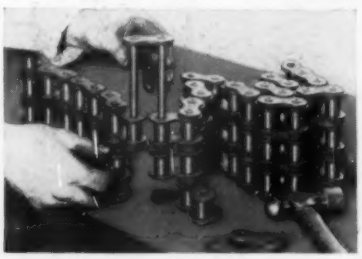


Remove rivet heads on the pin link with a grinder or chisel. Pin link adjacent to connecting link is the one usually cut

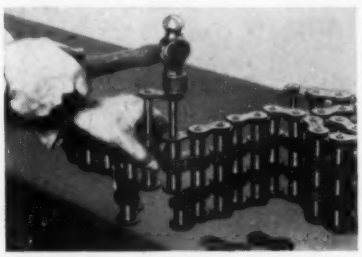


Drive pins out of the side plate, using a punch and hammer. Strike the pins alternately to avoid distorting plates

Reassembling



Insert the pins of pin link in top pair of roller links. Then line up the inner plates and the next pair of roller links



Drive repair link pins through the inner plates, striking the pins alternately. Repeat until all roller links are engaged

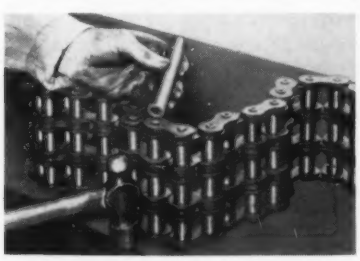
Install and cut your roller chain right

Initial care in installation will repay you well in added roller-chain service. Here are easy steps to follow when putting a chain in use, or when removing a roller link. Based on the Chain Belt Co's "Helpful Hints for Chain Users"

► To PROLONG your chain's usefulness, you must know how to install it properly, and how to cut and reassemble it without harm. Cardinal points to keep in mind are: (1) Watch alignment during installation. (2) Be careful of plates when cutting and reassembling.

Install chain. Remove connecting link, wrap middle of chain over one sprocket, ends over the other; reinsert the link

Remove side and center plates as pins are driven out. You can work with chain in place on sprocket, or on a workbench



Invert chain; put outer plate over pins. Use a hollow punch to seat plate. Attach cotters or clip; be sure the joint flexes

No. 7 of the Bill Eddy cartoons

Repeated by request

"Spargrove's been getting nice results with his 'algae control' lately"

for long life

Here are tips on how to do the job.

Installing. Carefully level the shafts, using a spirit level across the teeth for multiple-width sprockets, or a machinist's level on the shaft for single width.

Then make sure shafts are parallel by measuring distance between them, on both ends of the shafts. Recheck level adjustments and tighten securing bolts.

Align sprockets axially on the shafts, checking with a straightedge or a stretched wire, depending on center distances. Be sure straightedge contacts the finished edges of both sprockets.

If there is end play, align the sprockets with shaft in running position. Determine this by chalking the shaft, running motor at operating speed, and scribing a line in the chalk opposite a convenient fixed point. Block shaft in this position, and adjust alignment. To secure sprockets against axial end play, tighten the setscrews. Use keys to prevent them from turning on the shaft.

Now you are ready to install the chain. Remove the connecting link, then wrap middle of the chain around one sprocket. Engage the free ends with teeth of the other sprocket and reinsert the link. Put on the loose side plate, secure it with cotter pins or spring clip and the job is done.

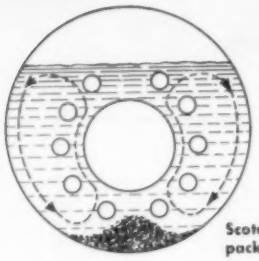
Adjustment is right if you can flex the chain slightly with your hand. It should not be tight on the sprockets. A vertical or inclined drive should have less slack than a horizontal one to assure proper mesh with the lower sprocket. Make final-adjustment check with the chain running under load. It it whips, there is too much slack in the chain.

Cutting. If you can adjust centers properly, a chain usually runs throughout its useful life without alteration. But you may have to shorten chain on a fixed-center drive, or replace a damaged link. Photos show the procedure.

Grind or chisel off the rivet heads. Then drive out the pins, using either (1) a long-barreled punch with small enough diameter to pass through the center plate holes or (2) a spare connecting link. When using the spare link, do not drive it into the center plates. Withdraw it as soon as you can fold back the free rollers, then drive the original pins out of the plates. Remove the freed plates, and continue driving with the spare link until pins are free from the chain. Always be careful to strike the pins alternately, to avoid distorting the roller link plates.

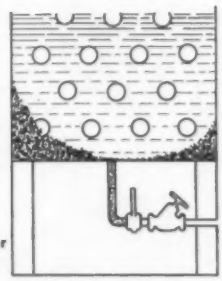
Reassembling. You can reassemble a shortened chain with a connecting link. The cut chain will be two pitches shorter, if you have removed one roller link. If this is too short, add one offset link adjacent to the connecting link. Photos show method for reassembling.

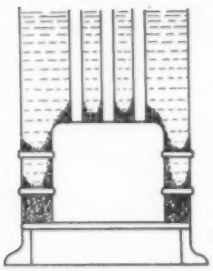
After assembly, make sure that joint flexes freely. If it is tight, strike the pin ends alternately with a hammer, to centralize center plates. If joint is still tight, turn chain over and tap the opposite pin ends until it is loosened.

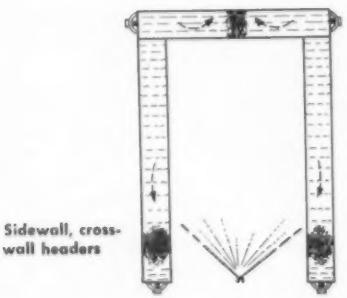


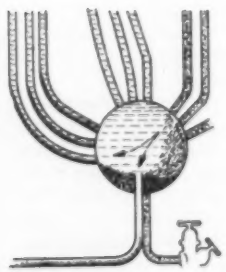
First of two basic articles . . .

Blowdown: the chemical









SLUDGE BUILDUP may occur as shown in: Scotch or package boilers with internal furnaces, rear-box headers of straight-tube boilers, sidewall and crosswall headers, mud drums of bent-tube units

► To get and hold good internal conditions in your boiler, there are two inseparable steps: suitable feedwater conditioning (Power, June 1953, p 76; Dec, p 99) and adequate blowdown. Neither does the job alone: each depends on the other for best over-all results. Whereas chemical treatment primarily affects cleanliness of the boiler proper, blowdown is relied on heavily to keep steam and process systems clean as well.

Blowdown job. Steam generation involves taking a raw material—water—converting this to the desired product—steam—and then getting rid of residual waste—boiler sludge. To hold peak efficiency, we have to restrict waste to a minimum, but not at the expense of contaminating the product or damaging the equipment. In other words, we want to lose only as much of the boiler water as we need to (1) avoid impure steam (2) avert frequent and costly boiler outage from scale buildup.

Before we can set the right rate of blowdown for any particular boiler, we must look at several angles. Let's lead up to them in easy steps.

Solubility. Any salt can be dissolved in water only to a limited extent. Beyond this *saturation point*, the water can't absorb any more. Or, if initial volume of water is reduced, some salt must precipitate out to comply with lower capacity of the smaller volume. Each salt has its own solubility limit at a given temperature.

Unlike most other salts, natural scale-producing ingredients of water—calcium and magnesium compounds — become less soluble as temperature rises. Since these salts have low-solubility capacities to begin with, they're prone to fall out of boiler water.

Sodium salts, on the other hand, have exceedingly high solubility limits and these increase at higher temperatures. Thus, even at high operating pressures, sodium limits aren't usually reached. Only in instances of starvation within waterwalls will the sodium salts be made to precipitate.

Scale formation. Ordinarily, hardness salts in natural waters are not at their respective saturation limits. At boiler temperatures they are, however, brought very near or just over saturation. Then, with steady evaporation and replenishing of fresh water, these salts become in excess and fall out.

Precipitating hardness crystals soon attach to boiler metal surfaces. Later, with increasing amounts, they fuse to a hard, solid scale. Such deposits impede heat transfer, often cause localized overheating of boiler metal. Rapid heat transfer at higher pressures makes even paper-thin deposits dangerous.

Correct internal chemical treatment aims at driving this hardness precipitation to completion and also at converting the calcium and magnesium salts into nonscaling forms. But care must be taken that soluble silica doesn't rise to concentrations that may deposit objectionable calcium and magnesium silicates. Such tendencies grow with increasing pressures.

Carryover. With calcium and magnesium hardness constituents removed, virtually all sodium salts remain. Now the fact that these compounds are quite soluble doesn't mean we can let them continue to concentrate unattended. As dissolved-solids content increases, boiler water becomes more and more viscous. Hence steam bubbles meet greater resistance in freeing themselves.

A goodly portion of the sodium salts will be in the form of alkalies, which give boiler water a soapy quality. The greater their concentration, the stronger the tendency for boiler water to foam.

Under these conditions, the steam is apt to carry boiler-water droplets with it. Thus we get wet, impure steam, with entrained solids that can erode prime movers and foul equipment.

Proper internal boiler treatment helps minimize carryover of suspended solids by effective coagulation of hardness precipitates. Foaming may also be restrained chemically. But production of high-purity steam depends to a large extent on mechanical factors.

Steam space. Where there's relatively little steam space—some forms of packaged units, for example—there's apt to be more sensitivity to carryover. Water-tube boilers may be less sensitive. Boiler design and rating comes into the pic-

By PAUL BRINDISI
Chemical Engineer, Celco Laboratories

control angle

Recommended limits of solids and other characteristics of boiler water

Psig →	*to 300*	*301-450*	*451-600*	*601-750*	*751-900*	*901-1000*	*1001 up*
Total solids	3500	3000	2500	2000	1500	1250	1000
Dissolved solids	2500	2300	2100	1900	1430	1200	980
Suspended solids	1000	700	400	100	70	50	20
P Alkalinity	500	420	340	260	180	120	80
Total M alkalinity	600	500	400	300	220	150	100
Phosphate as PO_4	100	80	60	40	20	10	5
Sulfite as SO_3	80	60	40	30	20	10	5
Silica as SiO_2	120	80	50	30	20	10	5

ture, too. A straight-tube job is apt to show greater turbulence in water circulation than a bent-tube unit when pushed to high ratings. And we have to allow for available steam-purifying facilities. These may range from a mere dry pipe in low-pressure units to intricate separators in high-pressure jobs.

Sludge buildup. Most boilers have sections of slow circulation — maybe even "dead spots"—where sludge tends to accumulate. We must watch for deposit buildups at these points. Vertical boilers, for example, can't sustain heavy sludge on crown sheets or within water legs. Scotch marine or package units aren't as sensitive because their shells do not form an integral part of the furnace.

In straight-tube boilers, dead spots may be found in lower corners of rear header. Watch out for sludge pile-up in cooler end of bent-tube mud drums. Too much deposit here may allow some sludge to be carried over into the sensitive waterwalls or up into the furnace bank. With sidewall headers, precipitates usually accumulate a short way in from front ends. In a crosswall header, buildup may be in center.

No amount of blowdown rids deposits from a dead spot. In fact, if such an accumulation doesn't occur, it's a good guess scale has formed somewhere else. Moreover, nature of this sediment indicates effectiveness of your chemical conditioning. Degree of pile-up shows if blowdown is adequate.

Even with consistently good blowdown, boiler efficiency will slide off because of slimy coating of generating tubes and sluggish circulation from increasing unsettled precipitates. These mean periodic washouts—an annual thorough cleaning and midyear washing for most boilers, more frequent washouts for others.

Suspended solids. Let's assume we've got filtered makeup and our feedwater contains 120 ppm total dissolved solids, of which 80 ppm is total hardness. In the boiler, temporary hardness decomposes and is forced out of solution. Remaining permanent hardness is driven from solution by treatment. Since correct conditioning calls for complete removal of hardness, entire 80 ppm of feedwater hardness goes down as precipitated solids.

If, instead, makeup is unfiltered water contributing 30 ppm of natural suspended matter, total precipitable solids will then be 110 ppm. This difference increases considerably when multiplied by concentration in the boiler. Since we're limited in amount of suspended solids boiler can sustain, rate of blowdown must be higher for unfiltered makeup.

Low-pressure large-volume boilers normally tolerate about 1000 ppm of suspended solids. But limits are progressively lower for higher pressures and more compact designs. Table shows maximum allowable suspended solids recommended. These figures are a breakdown of total-solids limits specified by the American Boiler Manufacturers Assn. They serve merely as an approximate basis for calculations as no compensation is made for mechanical variations in boiler designs.

Dissolved solids. No two plants have identical operating conditions and no two boiler makes perform alike. Only through extensive field study can we learn how a specific unit will react to foaming, priming and carryover as ratings go up. From experience, however, we can derive a set of tolerable dissolved-solids limits, see table. These serve as a rough guide in setting blowdown needs in any particular case.

When we chemically treat the feedwater we talked about above, we exchange calcium and magnesium hardness for somewhat more sodiums. Also, we'll carry a slight excess of chemical correctives to insure holding zero hardness, desirable alkalinity and complete oxygen removal. Assuming that 5 ppm will thereby be added to the feedwater, we now have to contend with 125 ppm total dissolved solids.

For a unit operating at 300 psi, dissolved-solids maximum is taken as 2500 ppm. This is 20 times feedwater content, which means we can concentrate 20 gal of feedwater into one of boiler water before we need additional fresh water. That is to say, feedwater will undergo 20 cycles of concentration.

To simplify things, let's assume our boiler is a 20-gal vat. We can then evaporate 20x20 or 400 gal of feedwater before hitting the prescribed dissolved-solids limit. Beyond this point we risk getting impure steam. So we extract one gal of boiler water to insure safe operation. Now we can evaporate 20 gal of feedwater in its place, before having to blow down another gal of boiler water. Loss of boiler water here is 1/20th of feedwater, which is called a 5% blowdown. This is a moderate rate, both economically and mechanically practicable.

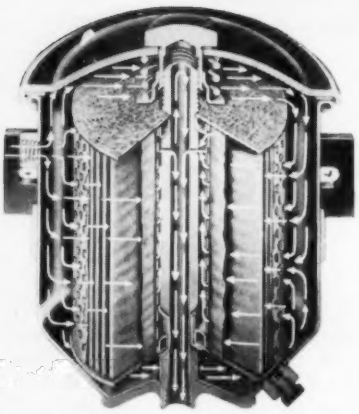
Other considerations. While boiler water's total dissolved-solids content is the over-all governing factor for adjusting blowdown, there are other angles. For instance, fairly high boiler-water alkalinities are desirable, to drive hardness precipitation to completion and retain silica in solution. But strong alkaline concentrations induce foaming and carryover.

Suppose we find the above boiler water developing a total alkalinity of 800 ppm, from the alkalinity of the natural water and from chemical treatment. We also see that existing steam-purifying equipment can't cope with this and boiler-water turbulence intensifies foaming. First care must be to protect prime movers from carryover deposits even though it means more blowdown and greater waste of boiler heat units. So, to keep alkalinities in a safe range, we reduce feedwater concentration cycles to 15. That means a blowdown rate of 6.7% instead of initial 5%.

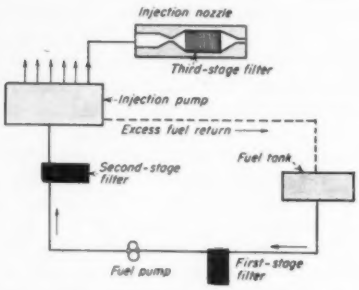
Let's take our example forward another step. Now boiler-water silica content is developing to 150 ppm. We note, also, that boiler sludge shows a marked tendency to harden and its analysis reveals some silicates. We must again revise concentration cycles downward to hold silica in check. This time we go to 12 cycles, which fixes final blowdown rate at 8.3%.

At higher operating pressures there are still other restricting factors. Boiler-water dissolved solids tend to decompose and produce damaging gases such as silicic acid, sulfur dioxide, hydrogen sulfide and ammonia. At 600 psi or

(*Continued on page* 190)



1 Resin-impregnated, pleated micronic-paper is one of the popular filters



2 Typical hookup for protecting the injection system of diesel engines

Jules P Kovacs, v-p of engineering, Purolator Products, Inc, says . . .

Select the RIGHT diesel filter

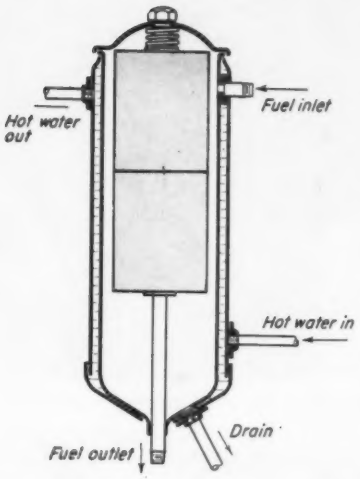
► FILTERING FUEL and lube oil, also intake air, with the right filter before they pass into your diesel engine is an important way to reduce bills. First let's see what contaminants must be filtered: (1) atmospheric dirt (2) casting sand, from engine parts (3) metal particles, from wear or chipping (4) water (5) sludge from fuel, carbon or coolants in oil (6) pieces of gaskets, seals or paints (7) acids and (8) results of oil deterioration, such as polymerization, oxidation and sludge.

Most damage caused by these contaminants is from particles over 10 microns in diameter. Those smaller than 10 microns are carried in suspension by oil film, which is 5-10 microns thick. Many tests, made to show how filters prevent damage to engine parts, always prove that contaminants passing through engine shorten components' life. Foreign matter in lube oil causes wear or scored cylinders, bearings, connecting rods and pistons. Solids in fuel oil can also block nozzle openings and wear parts of injection system.

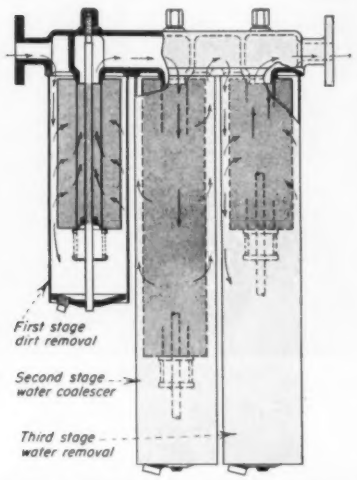
Depth-type oil filters have cans or socks packed with material like cotton waste, or diatomaceous earth. These materials present a long, tortuous flow path, giving impurities many chances to be removed from fluid stream. But depth-type filter has these disadvantages: (1) higher pressure drops in system (2) removal of useful additives in lubricating oil (3) limited filtration area as effective area is governed only by diameter of element rather than its depth, and (4) flow inconsistency caused by variations in packing and unloading.

Surface-type filter is more widely used in recent years. Filters, with this principle, trap foreign particles on surface. They build particles into a cake, composed of small capillaries that act as additional filtering channels of depth type. Most popular of these surface filters is the resin-impregnated, pleated, micronic paper-type design. It combines a large filtering area with a low-pressure drop. This type element is easy to service because you simply throw it away when it becomes clogged.

Metal-edge type is another surface filter (*held by author, photo*). It's often



3 Heating jacket on filter reduces the viscosity of oil for better filtering



4 Three-stage filter can remove most of the water in various types of oils

formed by helically winding a ribbed metal ribbon into cylindrical form. This cylinder has tiny openings around its surface, which give a large open area with relation to over-all outer surface.

Elements of this type often have a scraper rotated manually or automatically to remove the accumulated particles from outer surface.

This type element is especially useful when very high temperatures or pressures make paper elements useless. Self-cleaning feature is an advantage if operator must clean filter without shutting down machine as he would have to with a throwaway element.

Air entering the diesel may also contain harmful air-borne dust, water and unburned exhaust-gas products. Remove these contaminants by one of several types of air cleaners.

Most common cleaner has highly effective mass of wire mesh or animal hair wetted by an oil spray. More recent development uses a resin-impregnated, micronic paper-element, similar to that used in liquid systems. Here again, advantages of a large-area low-pressure drop and good dirt-holding capacity are important.

Typical filter hookup for protecting injection system is shown in Fig. 2. This 3-stage installation gives a very high degree of fuel-oil cleanliness, regardless of outside conditions. Fuel passes from tank through the first-stage filter. This is preferably the metal-edge type with knife cleaner. Filter removes an extremely high percentage of contaminants before fuel passes through pump. Second-stage filtration is often desired after pump for added insurance. Second-stage filter might be a resin-impregnated, micronic paper type of element, capable of removing particles as small as one micron (4 millionths of an in.).

Extremely critical jobs need a third-stage filter. This is a small metal-edge-type element inserted before nozzle. It removes particles that might wear from injection-pump parts. Such strainer may be as small as $\frac{3}{8}$ in. in diameter and $\frac{3}{4}$ in. long.

Purifiers have been used for lube oil in lieu of filters. These purifiers consist of large settling tanks and heating chambers. Purpose is to drive off impurities and water collecting in oil. Oil is changed at intervals and passed through the purifiers, then re-used. If large investment in such purifying equipment isn't practical or if you can't shut down for long, filtration system may be used instead of purifier.

Special problems often come up in filtering fuels for stationary diesel engines. For example, an oil company wished to begin pumping operations from a group of wells. They wanted to use some high-output 8- and 12-cylinder V-type diesels, with multiple-plunger injectors that were available. Complications arose because wells were in rough terrain and far distant from highways and roads. So transportation of No. 2 fuel oil was impractical.

Solution was using crude oil directly from well. Crude could be burned but large amount of impurities called for a highly efficient filtration system. In the crude were found impurities like oil brine, emulsions, water, iron, sodium, acids, ash, and the sulfates of calcium, manganese and copper. First efforts at filtration were made with devices in the following order: (1) settling tank (2) treating tank, containing treating material (3) centrifuge and (4) cleanable, metal-edge filters.

System handled 30 gph. After checking, we found that fully 4% of oil by volume consisted of removable solids. But system wasn't satisfactory because of high cost, ineffective performance of settling tank below 70 F. Also because of time lost to replace treating material and time needed to clean out metal-edge filters.

We tried a new approach, by using micronic convoluted, impregnated, cellulosic elements that removed particles down to 2 microns in size. For one 200-hp engine, two filters were installed in parallel. Each filter had two elements with 3000 sq in. of filtering area. That gave a total of 12,000 sq in. for filtering during flow through both passages.

With filters in parallel, each could be shut off from flow separately, then cleaned with other in operation. For larger engine sizes, we only had to add more filters in parallel. For example, 400 hp required four filters.

Operating this system in cold weather required special devices to reduce viscosity of oil to increase filter effectiveness. Fig. 3 shows this filter with heating jacket. This jacket was supplied by hot water from engine's circulating system, although steam could be used during very low temperatures.

System worked well, removing impurities that would otherwise have clogged injection system. Element life averaged 2000 hours each. Besides being more efficient, about $10,000 per installation was saved over the previous job.

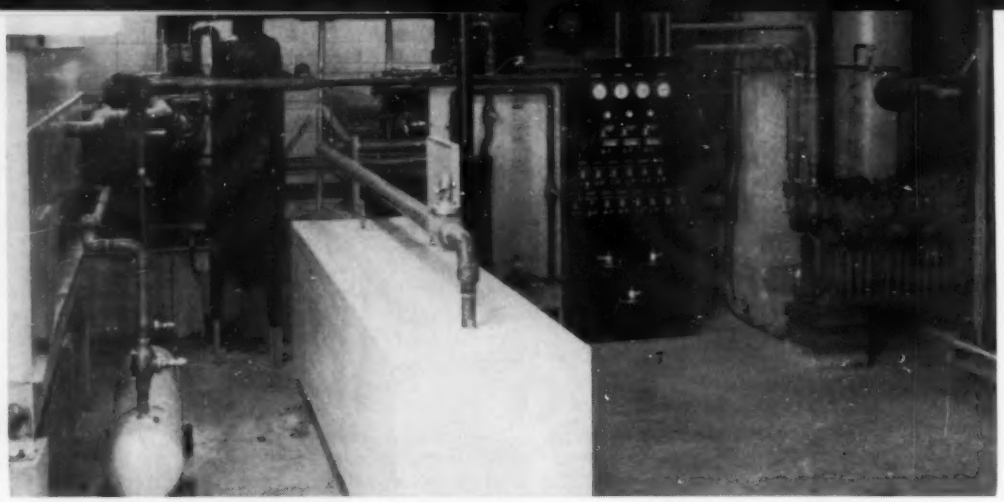
Another special problem that often arises is removing water from fuel oil. Typical filter we designed for this purpose has three filter elements mounted in a common housing, Fig. 4. Oil passes through each element in turn. First element is a resin-impregnated, convoluted micronic paper-type. It removes most contaminants present. Oil enters housing at top, passes through the element, outside to inside, then passes through manifold into second-stage element. This stage has special fibers, which have property of causing water in oil to coalesce and flow along with oil in form of large drops.

When oil and water drops reach third-stage element, which is identical to first-stage, comparatively large water droplets are easily removed by filtering medium. Such installations can remove 99.9% of water by volume from oil where original concentration of water is 5% by volume. This is at a flow rate of 5 gpm, with a pressure drop of less than 5 psi with oil at a viscosity of 45 ssu at 100 F.

I hope this information will help you do a better filtering job in your plant.

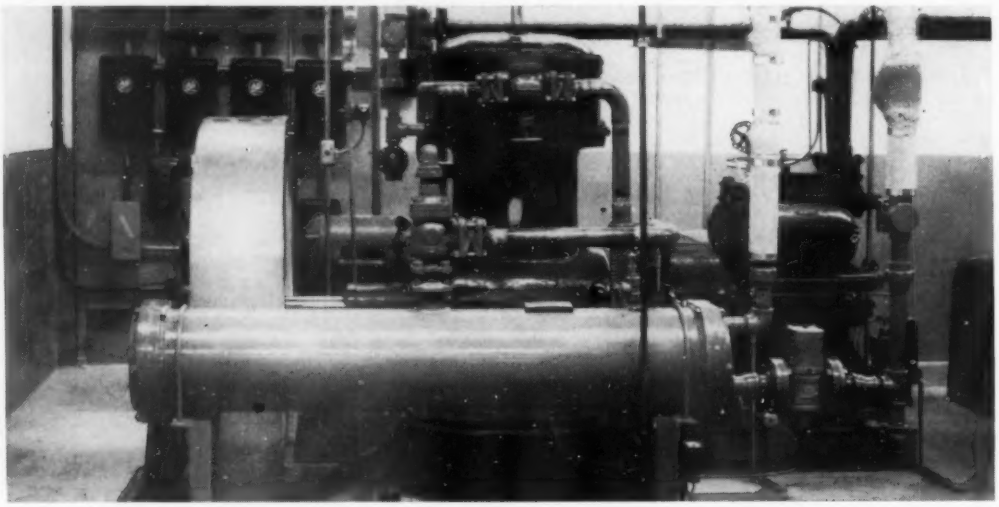
REFRIGERATION

FREON-13 & FREON-22 2-STAGE CASCADE, MINUS 110 F



2-STAGE Freon-13 and Freon-22 cascade system with minus 110-F evaporating temperature . . .

FREON-22 3-STAGE COMPOUND, MINUS 110 F



3-STAGE Freon-22 compound compression system with minus 110-F evaporating temperature . . .

You can cut power costs 58% on ultralow-temperature refrigeration. Here's an expert's own report on how today's newest refrigerant . . .

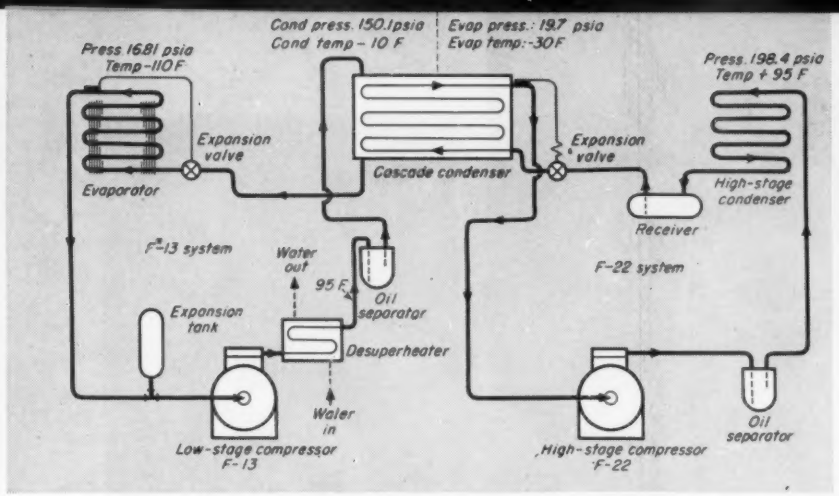
. . . Freon-13 operates in cascade

► "THIS PIECE of equipment must operate successfully at sub-zero temperatures." You'll find statements like this in many of today's industrial-product specifications. Aircraft parts, instruments, special-purpose clothing, pharmaceuticals, plastics and metals, to mention just a few. Often these products must be tested at temperatures as low as minus 100 F.

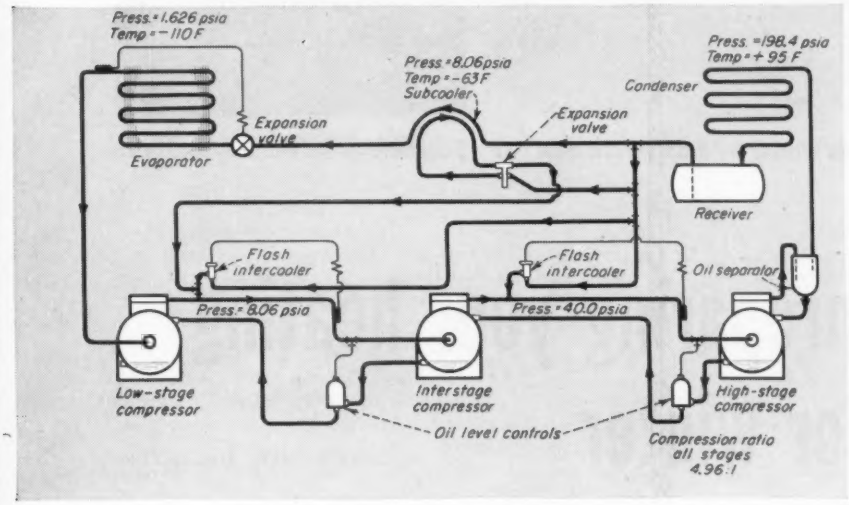
Hardening of metals. In addition to research and production testing, many in-the-know plants are taking advantage of the hardening effect of sub-zero treatment on metals. In steels, for example, for the same degree of hardness the cold-treated tool is tougher than the heat-treated one. Also, for the same degree of toughness, the cold-treated tool is far harder. This means longer life for cold-treated tools.

When high-alloy steels for gages are finished to a close tolerance after ordinary heat treatment, they may undergo changes in shape and dimensions over a period of months or years. Cold treating of precision gages and close-fitting parts before finishing will stabilize the steel—avoiding distortion that might otherwise occur.

Shrink-fitting. Assembly practice has long included the technique of heating and press fitting. Sub-zero treating by cooling male parts for easy fitting into female parts eliminates many of the disadvantages of heat treating. Sub-zero treated parts do not (1) oxidize when raised again to room temperature (2) require additional finishing, or (3) suffer any appreciable change in either metal characteristics or dimensions. Result: Faster, safer, and more econom-



. . . and minus 100-F air temperature. This unit is for high-altitude test chamber



. . . and minus 100-F air temperature. Photo shows compressors and condenser

By **FRED HERMANN**, *Project Engineer*
Tenney Engineering, Inc, Union, N. J.

systems at minus 110 F

ical fabricating and assembly methods.

The refrigerant. The first requirement of a good ultralow-temperature refrigerant is that its boiling point at atmospheric pressure be sufficiently low. But this alone won't satisfy the smart refrigeration-equipment operator. He also wants it to be colorless, odorless, tasteless, nontoxic and nonexplosive. All it takes is a small shaft-seal leak at the compressor and someone lighting a cigarette for the explosive refrigerant to wreak havoc with lives and equipment.

The hydrocarbon refrigerants, methane, ethane and propane, meet our first requirement: very low boiling point. But they're explosive! If you do use these refrigerants make sure to take the necessary steps to protect your operators. Chances are you'll also be faced with higher plant-insurance rates.

After exhaustive search for a really safe low-temperature refrigerant, chemists came up with a new member of the Freon family, Freon-13. In common with other Freon refrigerants, Freon-13 meets all the safety requirements we've mentioned. In addition, it has an extremely low boiling point at *relatively* high pressures. This is the property engineers look for. A comparison of boiling points of Freon refrigerants at atmospheric pressure looks like this:

	Boiling point
Freon-12	minus 21 F
Freon-22	minus 42 F
Freon-13	minus 114 F

Allowing a 10-F temperature difference between Freon-13 and air, it's no trick to get below minus 100-F air temperature.

Compound compression system shown in lower picture and diagram uses a single refrigerant, Freon-22, to reach minus 110 F in three stages. The unit operates with three compressors and flash (direct mixing) intercoolers between stages. Subcooler serves a twofold purpose: (1) Subcooling main refrigerant flow prevents flashing before expansion valve to evaporator. (2) Even more important, in bypassing some refrigerant directly to discharge of low- and intermediate-stage compressors, we cut down weight flow of refrigerant to these units. This is especially important on the low stage where very low density of the refrigerant would force us to use an unnecessarily large compressor. Note also that we do all our intercooling with the refrigerant that bypasses the low- and intermediate-stage compressors.

Because of different pressures in each compressor, we need oil-level controls to maintain equal level in each unit.

Cascade system shown in top picture and diagram uses two refrigerants. Freon-22 (high stage) condenses Freon-13 in cascade condenser. This setup is nothing more than two simple systems in series. The cascade condenser is actually both the high-stage evaporator and the low-stage condenser. By putting two refrigerants to work at the temperatures where they are most effective we pick up several advantages over the compound

(*Continued on page* 212)

Why use low temperatures?

- **Research and production testing**
- **Hardening of metals**
- **Size control of precision parts and assemblies**
- **Shrink fitting**
- **Storage and preservation**

BRRR R R—avoid heating failures this winter by doing work now . . .

Schedule maintenance at once . . .

14 Q&A on preparing your heating system now for winter

By STEVE ELONKA, *Associate Editor*

1 What's best time to overhaul building heating system?
A Most building operators do this job when equipment comes off the line in spring. It's best to clean boiler and sooty ducts as soon as system is shut down. Reason is that ashes and soot absorb moisture from humid air. Because of sulfur in these deposits, resulting sulfuric acid rapidly corrodes the metal.

2 Is galvanic action a problem in hot-water heating systems?
A Galvanic action can be a very serious problem because of dissimilar metals in piping, fittings, heat exchangers, boilers, etc. Galvanic action precipitates iron into water, which lowers pH down toward acid condition.

Water going toward acid increases galvanic action, which in turn precipitates more iron, causes oxidation—corrosion. If water is not treated for five to ten years, look for serious trouble. If organic compounds are used, 1 part in 500 parts of water often prevents trouble.

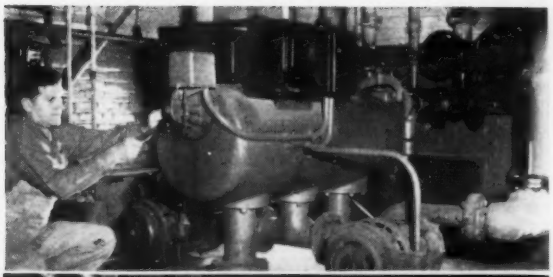
3 What equipment in heating system should be checked?
A Everything. Follow system through building and come back to boiler with return system. Take in all piping and check joints for leaks, corrosion and condition of insulation.

4 Should hot-water heating systems be drained in summer?
A Many large buildings have hot water heated by steam in heat-exchangers. Hot water is then circulated through space heaters. Many air-conditioning systems having chilled water are now being adapted for hot-water heating in winter. Chilled water is usually at 40 F, while hot water may be anything over 180 F. But slime and algae form in such systems when water is under 140 F. Because oxygen is gradually liberated from system while water is hot in winter, don't drain in summer, but treat water chemically.

5 Radiators: What maintenance is needed?
A Check for physical defects—usually they need little maintenance. Some steam radiators have orifice plate on inlet side between valve and radiator. In that case they have no trap on outlet side. If it's a high-pressure system, you might take coupling apart once in five years or so and check hole size in orifice for wear. Radiators that don't heat properly usually have fouled valves. Make sure air bleeder valve on radiator works.

When trap is on outlet, renew valve disk if needed, or grind in. If the packing gland of valve is screwed down all the way, remove old packing and put in new.

6 Unit heaters of the ceiling type: What maintenance is needed?
A Coils of small unit heaters often spring leaks. Check by placing pressure inside coil. Open steam trap and clean out, check valve seat and disk, also bellows for cracks. Check electric motor on unit. Clean out motor and grease bearings. Don't forget that more motor bearings are burned up from



Check returns and all the traps . . .

To keep your building warm on coldest days

overgreasing than from lack of lubrication. If in doubt, leave out plug of bearing and run motor so excess grease can run out. Then screw in plug again. If unit has fan, clean the blades. This allows them to run more freely and also keeps them from getting out of balance, which loads the bearings and shaft.

7 Valves: What attention is needed?
A All valves in system, whether you buy or generate your own steam, should be checked for tightness, packing, good working condition. Best way is to lift valve bonnet. Then you can usually see if valve is tight by observing seat and disk condition. At times a valve needs a new stem, or packing may be hard, then leak steam during heating season.

8 Expansion joints: What attention is needed?
A Expansion joints are often of slip type. Because there is constant movement in this joint when steam is turned off and on throughout zone, you should repack joints each summer. Before doing so, shine sliding part with fine grinding cloth to make sure no burrs or scale cut packing.

9 Reducing valves: What attention is needed?
A Besides large reducing valve that steps down steam from utility firm as it enters building, there may be other reducing valves at various zones of either high or low pressure. One zone may operate on as low as 1 psi while another uses 50 psi. Open each reducing valve, check valve seat and disk, and other internal working parts.

Diaphragm may be critical part, although that depends on design and material. If there are any indications of failure from constant flexing, it's good insurance to replace diaphragm with new.

10 Condensate pumps: What attention is needed?
A Clean electric motor and lubricate same as any motor in system. Because this unit can shut down entire system, have only responsible person do work. Check float for leaks and clean out condensate-return tank if needed. Float may leak, get gradually water logged.

Remove packing from pump shaft and check shaft for grooving. If heavy wear, check pump and motor alignment. Best way is to break coupling (remove bolts) and use dial indicator. Don't assume that equipment stays in line just because it was in line at one time. Misalignment is costly.

Most pumps of centrifugal type need little maintenance, especially on condensate-return system. But checking wearing rings and impeller often shows that parts need renewing.

11 Return piping: What attention is needed?
A Leaks and corrosion are very common in return lines. Look for corrosion around piping connections, especially at threads of nipples. If portion of your return line is buried, check for leaks as that is where corrosion takes place. Put hydrostatic test on buried section of pipe. If possible, run piping in covered trench to avoid future headaches.

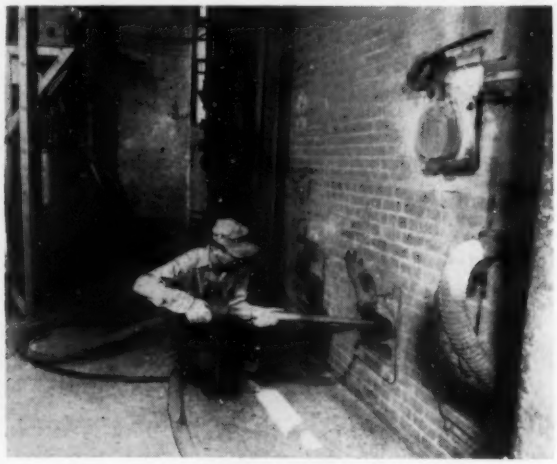
12 Relief valves: What attention is needed?
A New type relief valves on hot-water boilers are tested and approved by National Board of Boiler and Pressure Vessel Inspectors. They are stamped showing they comply with ASME Heating Boiler Code. These valves, rated in Btu discharge capacity of either water or steam, are more reliable than older type valves. Insurance firms advise renewing old valves with this newer type.

13 Controls on boiler: What maintenance is needed?
A Safety valve should lift easily when test lever is raised. Clean water column so water level is easily seen in glass. Experience shows that if automatic water column is attached to boiler and water column, draining weekly during heating season keeps it working right.

Summer is time to check low-water fuel cutout, emergency water feeder, pressure controls and firing controls. This includes any automatic firing device. Take low-water fuel cutouts apart and check carefully. If manufacturer has local service center, let him do this work. Or you might return equipment to factory.

14 What is common cause of radiators or other space heaters, which are supplied by one riser in system, not heating while other units do heat?
A Building sections that support piping and hangers often settle, which may restrict circulation in riser. Heaters on other risers may have good circulation at expense of one that has settled. To avoid, check all possible places where settling might take place. Do this every summer when lines are cold and then elevate the risers to their original positions.

Newest PRACTICAL IDEAS for a bang-up job to cut



Before and *after* shots show progress in recovering unused coal from boilers

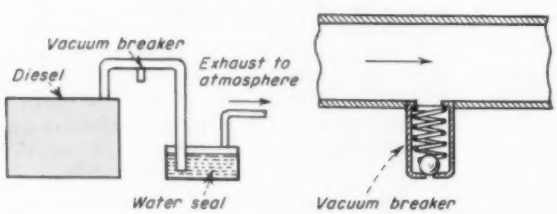
We fire rice and barley coal, fed from hoppers onto chain-grate stokers. About 3 tons of fine coal slip through the 21-ft-wide chain grates each week into the windbox, while ashes fall into another section.

We used a hoe with a 16-ft handle, made in sections because of space between boilers, *before* photo. Then we installed a central vacuum-cleaning system, which we use for removing this coal, *after*. The job that once took 48 man-hours is now done by three men in 6 hours.

Coal is picked up with vacuum of 9-in. mercury, pulled by a 790-cfm exhauster. Vacuum carries coal back through system where it's collected in primary separator having 30-ton capacity.

Recovered coal is dropped through a hatchway at bottom of separator into a large lorry. That takes coal back to furnaces' coal hopper for reuse. Fine particles and dust are reclaimed by a vacuum-driven flyash reclaimer, connected to top of secondary separator. Reclaimed fines are blown directly into the fire bed for their fuel value. Beside saving money, job is much cleaner.

J K Kroboth *Clifton, N. J.*



Safe way to arrest those exhaust sparks

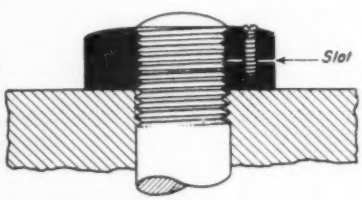
I had to vent exhaust of diesel-powered shovels so sparks would not explode vapors of buried 100-octane gasoline tanks. Obvious solution was to pass exhaust gases through tank of water before letting them escape to the atmosphere.

But there was danger when machine was shut down that vacuum produced from cooled cylinders might suck water back into cylinders. To avoid this, I installed a vacuum breaker on exhaust pipe, *sketch*. It has a small spring-loaded steel ball.

This worked until one day a machine had a bad accident. Cylinder head had split wide open, connecting rod was bent and engine wrecked. What happened? Carbon, unburned oil, and other sticky stuff from exhaust had gradually settled on vacuum breaker ball, gumming it up solid. Then water was sucked back into cylinder, just as I feared.

This time we solved problem with a 4-in.-diameter aluminum ball on a 1-in.-diameter seat. Operator had standing instructions to jiggle the ball at least once a day to make sure it worked freely. This design did the trick. We had no trouble thereafter. This incident taught me one thing; unless you fix it right, there's sure to be an accident.

E John *Chicago, Ill.*



Lock that nut

To lock a nut that's in a vital spot, saw into one-half of nut, *sketch*. Drill vertical hole and tap. Then fit with a screw. When screw is tightened, nut will bind the two sets of threads together.

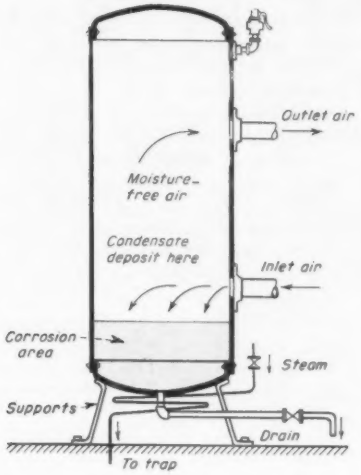
To lock the small screw, coat its threads with shellac or varnish before inserting. Then threads will be bonded together.

I've found that bond can be broken only by heating the nut just enough for it to expand. If you have enough heat to penetrate the screw, you'll never loosen it.

W E Warner *Woodford Green, Eng.*

your costs of operation and maintenance

STEVE ELONKA, *Associate Editor*



Inspect your air receivers

WHEN INSPECTING air receivers for corrosion or cracks, look out for WATER. This may come from condensation on compressor cylinder walls, intercooler or aftercooler piping, from seepage of cylinder head-gaskets or intercooler tube-sheets, aftercooler tube-sheets or tubes themselves.

Vibration over a period of time attacks receivers' shell plates. Inlet and outlet nozzles suffer, supports crack, welded joints leak. Vibrating shell plate or air-receiver heads that corrode may cause a serious accident.

Keep internal surfaces free from corrosion. Scrape and brush clean. If oxide from pitting is found around nozzles, scrape off. Examine drain nipple attached to head (if vertical tank) for corrosion and wasting away in threads. Renew drain nipples every five years. External inspection includes piping and safety appliances, including the drain. Lower heads of vertical tanks become badly corroded. Also, drain piping from head to drain valve or cock, especially where such heads are buried in insulating material. Paint heads annually.

Severe winter conditions create hazards in outside air receivers. Then drain pipes freeze and burst. Insulation and steam coils can prevent freezing of lower heads and drain piping, *sketch*.

Examine supports for corrosion, cracking and settling. You can trace causes of vibration in compressing units, and its effects. Never use old tanks unless inspected and cleaned. Never replace an old air receiver with a tank constructed for a lower pressure.

J M GORRIE *Lansing, Mich.*

What would you have done?

I WAS WORKING as a fireman for a local cannery. We had one 20,000- and two 10,000-lb-per-hr boilers. At beginning of canning season, cannery operated during daytime only, so boilers were fired up at 6 am and shut down at 6 pm. Nonreturn valves on all boilers were closed when boilers were shut down. Feedwater valve lines were also closed, but some valves were not tight.

Arriving at work one morning, I could hear water-column whistles blowing. Chief arrived about the same time. One boiler whistled because of high water, other because of low water. Boiler with low water had about 40-psi steam. Boiler with high water had about 50-psi steam. Normal operating pressure on this boiler unit was 150 psi.

Steam pressure was too low to start duplex feedwater pump. Pressure would have dropped further upon opening a boiler nonreturn valve to get steam to pump. We could have blown down boiler with high water and stopped whistle from blowing.

Chief had a bright idea. He closed feedwater valve at the pump and opened feed-line valves to both boilers. Because feed line checks on boilers leaked, boiler with high steam pressure and high water level forced water back into feed line and into boiler with low water. Both water whistles quit blowing and we fired up. What would *you* have done?

C TRETINYAK *Rochester, Minn.*

Here's what I would have done in finding vacuum leak (*Power*, June 1954, p 137)

1. If unit's in operation—cannot be taken out of service:

Station a man at discharge of air ejector to atmosphere. Spray carbontetrachloride about flanges, screwed joints, expansion joints, shaft glands, etc, which are under vacuum. When man at air-ejector discharge to atmosphere notices carbontet odor, you're close to source of air leak. If you own a hydrogen leak detector (GE) it indicates carbontet if sampling nozzle is placed at air-ejector discharge to atmosphere. Sound-powered phone hookup between man at air ejector and man supplying carbontet completes the picture.

2. If unit is shut down:

Shut unit down and place on turning gear if so equipped. Gag atmospheric-relief rupture disks, if used, and install a mercury manometer connected to condenser, placed where a man at throttle valve can easily see. Keep circulating the condenser cooling water. Open throttle valve *slowly* until 1 psig exists in condenser-steam space. This must be done carefully, it takes very little valve opening. Be prepared to open vacuum breaker to maintain desired 1 psig. Leak will show up quickly because of pressure inside. Station several men around suspected areas that are under vacuum in normal operation.

I used this method on a 125,000-kw reheat machine with amazing success. You can locate leaks in areas that can't be water-tested.

J T BARRETT *Catonsville, Md.*

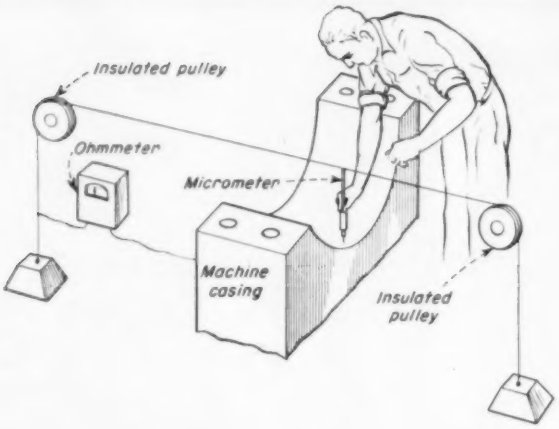
EDITOR'S NOTE: *We will publish the best answer for each incident and send a check making it worth your while.*

Did you know . . .

NEWEST TYPE of electron microscope magnifies up to 60,000 times normal size? But further enlargements up to 150,000 of normal size are made by photographing the image on microscope screen, then enlarging the picture.

More PRACTICAL IDEAS

Begins on page 124



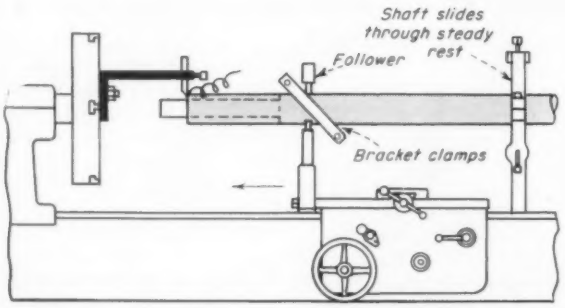
Take feel out of tight wire when aligning bearings

IN THE ARTICLE, "Now you can 'shoot' your bearings in line," (POWER, May, p 117), there's information on use of tightwire in alignment work. Listed under disadvantages is this statement: "Job is tedious and must be done by a careful mechanic with the right feel."

The mechanic must be careful, but to eliminate the "feel" we support tight wire on insulated pulleys, *sketch*. An ohmmeter is conected between tight wire and casing of equipment being aligned. Ohmmeter indicates when micrometer touches tight line. This method is more sensitive than "feel" and is quite simple.

There's no question but that optical method is more accurate and simple. While few places have a suitable optical instrument they do have micrometer caliper heads for this work.

G L ARTUS *Seattle, Wash.*



Here's your "trick of the month"

FOR TURNING DOWN the end of a long shaft in a short lathe, use method shown. First place shaft in follower and steady rest. After truing, clamp to follower so that shaft moves with follower and slides through steady rest, but does not turn.

Hold tool bit in angle iron, bolted to face plate as shown. By starting lathe, tool revolves around shaft and you can adjust diameter of cut by moving the tool toward the shaft.

Feed shaft against revolving tool with carriage. With this method, it's possible to take a cut off a very long shaft in a very small or a very short lathe.

I had this problem to solve one night while working as a lathe hand in 1891. When I came on at midnight, the foreman had a 16-ft-long shaft of 9-in. diameter at my lathe. "Turn this down for a 6-in. shrink fit 16-in. at one end," he said. My lathe had an 8-ft long bed. Before I could ask him how to do it he went home. But I had the job finished at quitting time next day.

M SURFACEBLOW *New York, N. Y.*

Editor's note: Send in your trick of the month and I'll send you a nice check.

Seepage or leaky pipe? Use boiler testing kit

REGULAR WATER-TESTING equipment for boiler and allied water-treatment control can be used by any mechanic to determine quickly if water leaks and seepage into a building and ground area result from defective water-supply-system piping in plant. Nothing to buy; you just use what you already have.

Water-supply sources are much like fingerprints—all different. And a plant source is definitely different from rain water or overflow from a river.

Comparatively rapid analysis of the plant source, matched against a sample from the suspected seepage or water puddle, quickly checks alkalinity, chlorides, hardness, and tells if they are one and the same water.

Water passing through the earth to different localities in a plant area is little altered from original in its chemical composition.

During recent rains and past floods in Missouri, I tested 17 different water deposits in locations around our plants —all suspected of being leaks. Seven were plant piping leaks; eight were overflow and seepage from rivers; one was from a leaky sewer line from a softened-water department area; one was a spring that had always escaped identification and location, for we had believed it to be a continual seepage.

This test saves a lot of time and expensive digging because you know what water is causing the puddles.

L W FITZPATRICK
Jefferson City, Mo.

Prevent fires caused by cutting torch

CUTTING oily steel plates can be hazardous because flames from cutting torch often heat the oil deposits to ignition temperature very quickly, causing fires.

One way to avoid such fires is to spread a thin layer of dry chemical over area to be cut. By doing this, the flames are extinguished before they get a good start, and production continues without any interruptions.

Courtesy, Ansul Chemical Company

Did you know . . .

THERE's a conductive rubber on the market? It differs from conventional rubber in that it has relatively low electrical resistance. This rubber is for flooring, matting, tubing, truck tires, table tops, belting, etc. Rubber makers will be glad to give information.

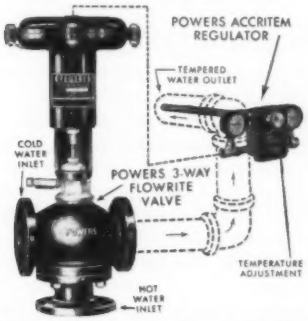
P W OLSON *Mt. Vernon, Ill.*

(*Continued on page* 128)

POWERS No. 11 Self-Operating REGULATOR with 3-way Valve. Thermostatically mixes hot and cold water. Delivers a mixture at any temperature desired. Valve sizes ½" thru 2". Capacities 20 to 250 gpm @ 45 psi. Write for Bulletin 329.

POWERS Type H Thermostatic Water Mixer. Used for many processes. Users report accuracy of ± ½° F. Insures utmost comfort and safety in showers and hand washing fountains and hydro-therapy. Capacities: 2 to 10 gpm @ 45 psi. Write for Bulletin 365.

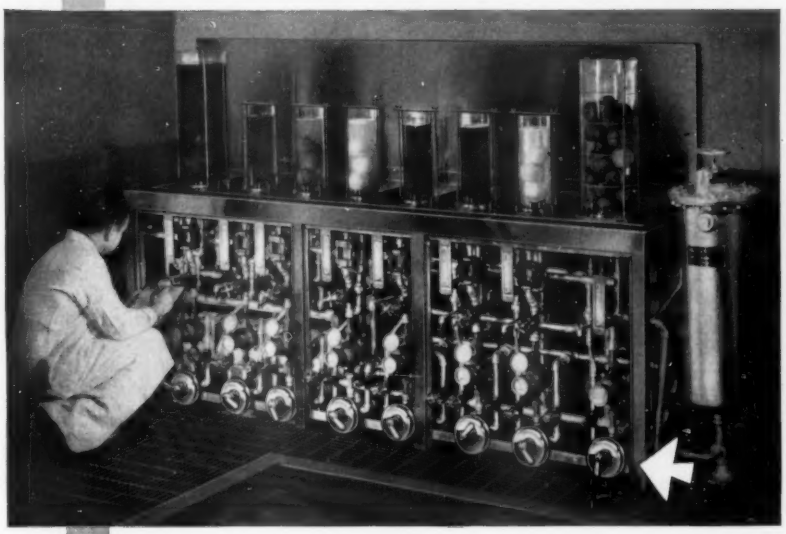
POWERS Thermostatic Water Controller. Capacities 22 to 125 gpm @ 45 psi. Used for gang showers, processes and hospital hydro-therapy. Write for Bulletin 361.



POWERS Large Capacity Thermostatic Water Mixing Valve. Controlled by an ACCRITEM Air or Water operated Temperature Regulator. Capacities 20 to 1200 gpm @ 45 psi. Temp. Ranges: 50° F. to 250° F. and 150° to 350° F. Write for Bulletin 316.

Nalco® Laboratories

got the Right Type of Control



for this testing operation

they called... POWERS

For Accurate Temperature Control of Water used in testing solubility rate of Nalco water treatment formulas, National Aluminate Corp. installed Powers Type H Thermostatic Water Mixers shown above. This is only one of many possible applications for this versatile temperature regulator.

Double-Safety of Powers Type H Mixers enable them to deliver water at a constant temperature regardless of **pressure** or **temperature** changes in water supply lines. Failure of cold water supply instantly shuts off delivery. Some users report ± ½° F. control. They often pay back their cost several times a year. Fully described in Bulletin 365.

Check your temperature control requirements with an experienced Powers engineer. Contact our nearest office or write us direct.

Some of POWERS Many Types of Controls that thermostatically mix hot and cold water and deliver a mixture at a pre-determined temperature are shown above. All are described in Condensed Catalog WC. May we send you a copy?

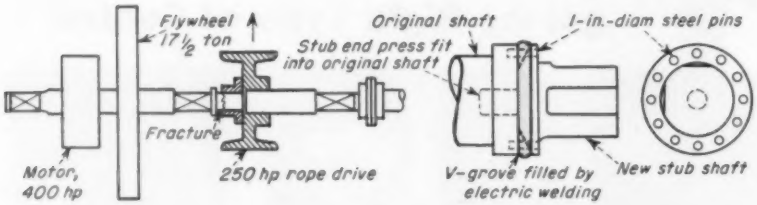
THE POWERS REGULATOR COMPANY

(b71) SKOKIE, ILLINOIS • Offices in over 50 Cities in U. S. A., CANADA and MEXICO • See Your Phone Book

OVER 60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

More PRACTICAL IDEAS

Begins on page 124

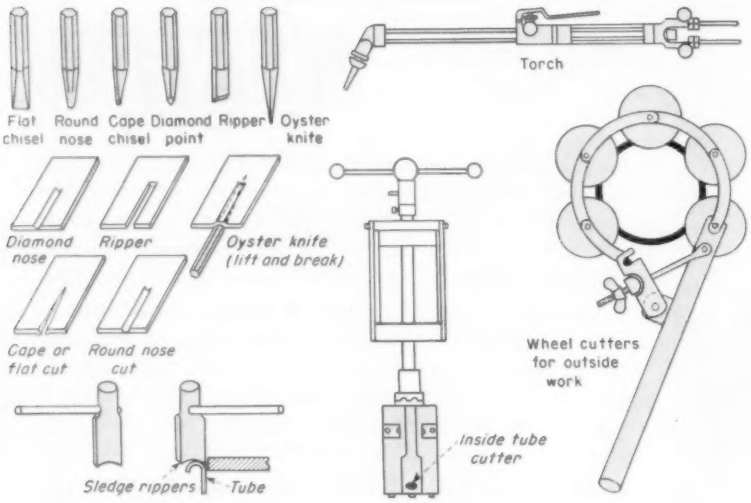


Repairing broken shaft of 400-hp rolling-mill motor

FRACTURE IN SHAFT of 400-hp rolling-mill motor threatened works shutdown. Dismantling the motor was a major operation because we had to remove a 17½-ton flywheel, *sketch*. Because of handling problems and need for machinery, we repaired broken shaft by fitting a new stubend to our shaft.

Shaft end fractured next to final reduction in diameter, *sketch*, where it entered coupling. We machined fractured section back to larger diameter. New stub end was made and keyed into shaft. Twelve 1-in.-diameter holes were then drilled through flange of new end and into original shaft for steel dowel pins. Pins were secured by filling up peripheral groove between original shaft and new end with electric welding. After aligning bearing that caused shaft to fracture in first place, we started motor. She has been running fine ever since. This idea may help you put your plant back in operation some day.

S SPENCE
Timperley, Cheshire, Eng.



Handy tools remove your boiler tubes

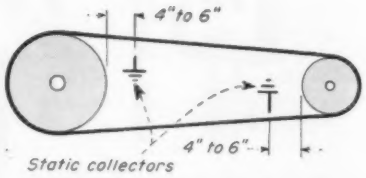
THERE ARE MANY WAYS to remove boiler tubes. Chisels used are flat, round-nose, cape, diamond and ripper. For this work, you need inside and outside cutters as well as oxyacetylene torch.

Simplest chisel is the cape. You can use it on return tubular boilers, but because of having to cut from inside the header or water leg on some types of boilers, job might be rough. A flat chisel that comes in same class is for removing beads. It's also good for cutting off short pieces from tube end.

Diamond-point and round-nose chisels both do cleaner job than flat chisel, but take care not to cut seat by working too deep. Use oyster knife with any type cutter to lift tube from its seat.

Sledge rippers do a good job on mud drum work and on long downcomers or on circulator tubes. Have two, one at right angles to the other as shown. For outside work, a 5-wheel cutter is handy. For inside work, cutter shown spreads cutting wheels against inside of tube.

ED DUFF *Aurora, Colo.*



Get rid of belt static

STATIC HAZARD can be lessened on belt drives by decreasing speed of belt and increasing size of pulley. Tests to find polarity of static charges show that charge is usually, but not always, negative. You should ground idling pulleys and metal belt guards within a few feet of belt.

Static electrical charges are generated on transmission belts from four causes: (1) friction of belt on pulley (2) separation of belt from pulley (3) flexing of belt and (4) friction of atmosphere on belt.

If machine is electrically grounded, a charge will remain only on belt. If machine is insulated from ground, potential gradually builds up as additional charges are generated on pulley. Rate that potential builds up on machine depends on electrical capacity and atmospheric conditions. V belts are less liable to produce static than flat belts, but should be protected in same way.

Most common method of preventing accumulation of static on belts and pulleys is to provide a grounded "comb," placed near belt surface.

P W OLSON *Mt. Vernon, Ill.*

Sure death to bugs

HOTEL ENGINEERS know how bugs from kitchen and food-storage rooms in building can overrun machinery spaces. After having this trouble in one building, I finally learned that the exterminator didn't do a thorough job because it would "work me out of a job." He didn't dust powder in all the places so he could keep coming back.

Recently I found a quick-killing insect spray called Bug Blast. I feel brother engineers might want to know about it. It comes in aerosol cans from Huntington Labs, Inc, Huntington, Ind. I spray this into crevices to kill roaches, silver fish, fleas, flies, etc. It also destroys eggs and larvae and is safe around food as it contains no DDT, is noncorrosive and nontoxic. I find this spray more practical than spraying dust. Might help engineers in hospitals, food-processing plants, etc.

R SILVERS *Rochester, Minn.*

YARWAY MARCHES IN THE KEELER "PACKAGE" PARADE

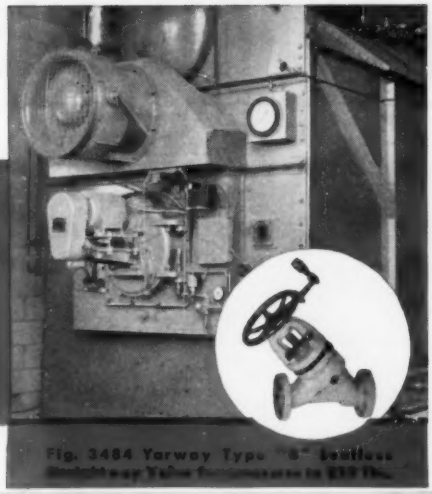


Fig. 3484 Yarway Type "S" Seatless

● Among other marks of quality on package boilers that "roll out" of E. Keeler Company's plant—are Yarway Blow-Off Valves.

Keeler knows what many other boilermakers know . . . that a *good* package-type boiler is *better* when equipped with Yarway Seatless Blow-Off Valves.

Over 15,000 boiler plant operators also know and appreciate Yarway Blow-Off Valves . . . their simplified design, dependable operation, long life, low cost maintenance.

Want more details? See Yarway Bulletin B-426.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

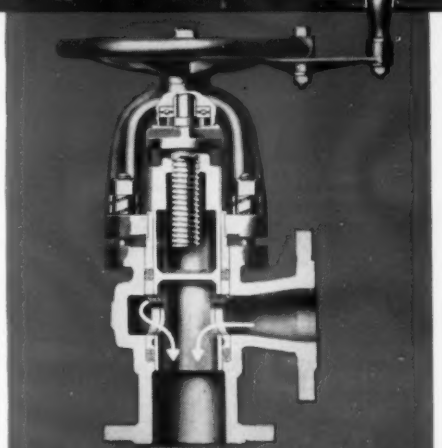


Fig. 3482 Yarway Type "S" Seatless Angle Blow-Off Valve shown in open position. Note balanced sliding plunger —no seat to score, wear, clog or leak. Pressures to 150 lbs. Other Type "S" Valves for pressures to 440 lbs.

YARWAY

blow-off valves

OTHER YARWAY PRODUCTS

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WATER COLUMNS and GAGES
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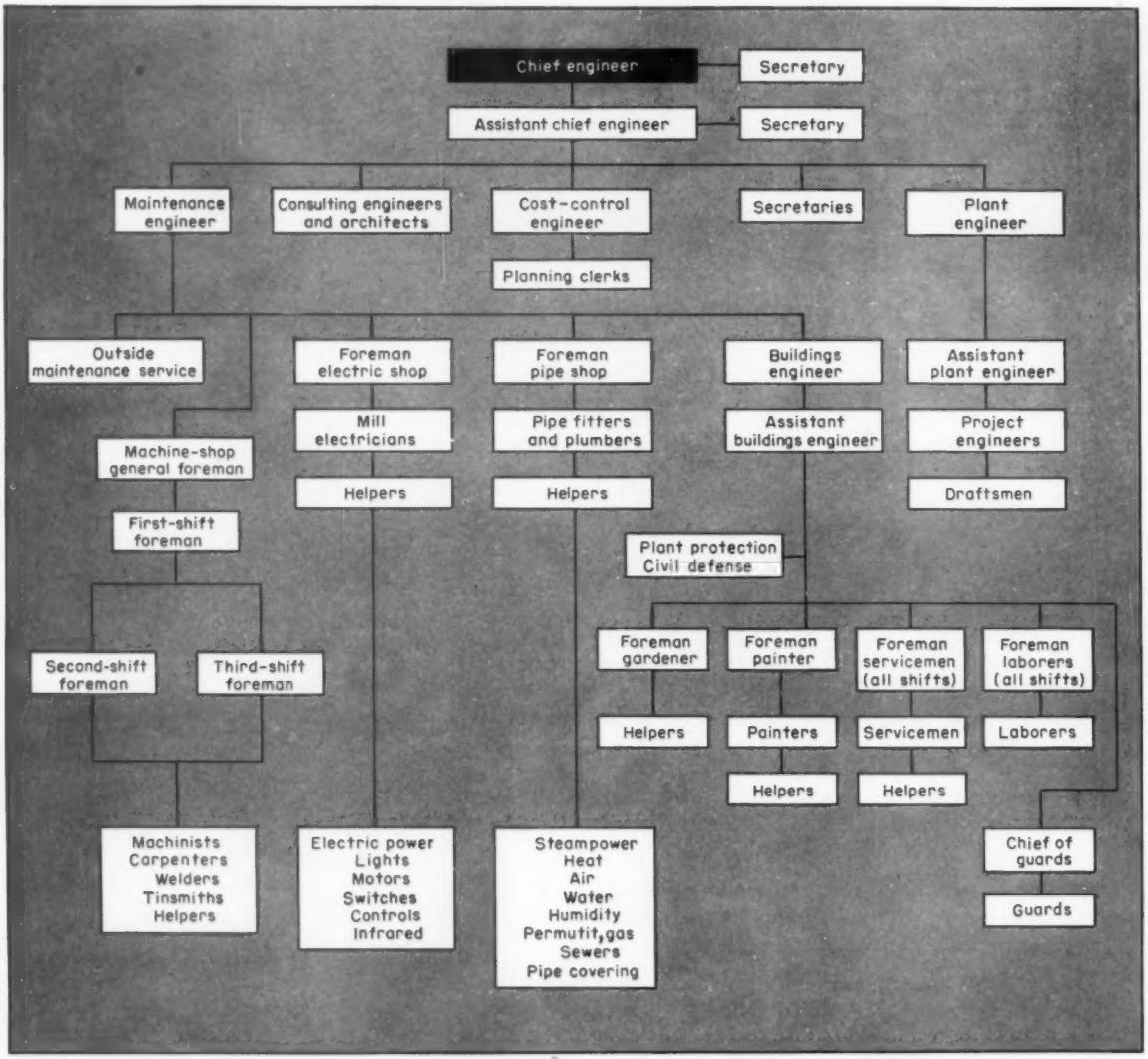
EXPANSION JOINTS
STEAM TRAPS
STRAINERS
SPRAY NOZZLES
DIGESTER VALVES

PLANT PROBLEMS . . . *helpful info from readers*



How can we set up our plant jobs?

HERE ARE THE FACTS: I have the task of setting up an organization chart for a medium-size manufacturing plant we plan to start soon. To be sure I'm on the right track, I'd like some help.

We expect to need mechanical, electrical power-plant crews. The plant has a number of the usual auxiliaries. What's the best way to arrange for operation and maintenance? ***—CC, May POWER***

Here are the answers

TEXTILE-MILL organization chart shows how the various jobs are classified. With this setup we have been able to keep production costs in line with other mills throughout the country. We have 1000 employes, with 120 in maintenance. Of the 120, 50 are craftsmen; the other 70 are builders, painters, guards, etc.

G A Estabrook *Albany, N. Y.*

MAKE UP the organization chart and

on job organization, pump protection

TYLER HICKS, *Associate Editor*

post it in a conspicuous place so every man in the plant gets a chance to study it. Then everyone will have a clearer understanding of plant management and operation.

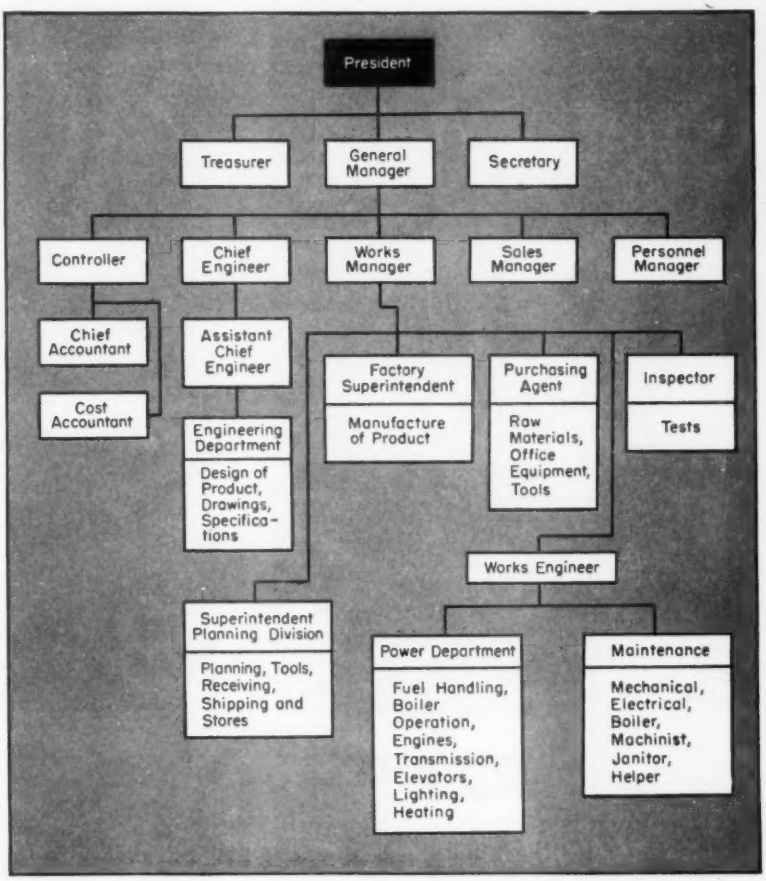
The chart shows a typical organization for a medium-size manufacturing plant. To be of more help to personnel, the chart should include the name of the person for each job title. As an additional aid, make up a similar chart for each department to show duties, names of workers, and their responsibilities.

The works manager is responsible to the executive branches for product output, starting from the purchase of raw and other materials, and going through to the finished item. This responsibility is shared by five supervisors: planning, factory superintendent, purchasing and works engineer.

Control of power and maintenance comes under the works engineer. All machinery and equipment for production, power and steam generation and transmission, and every phase of maintenance are his responsibility.

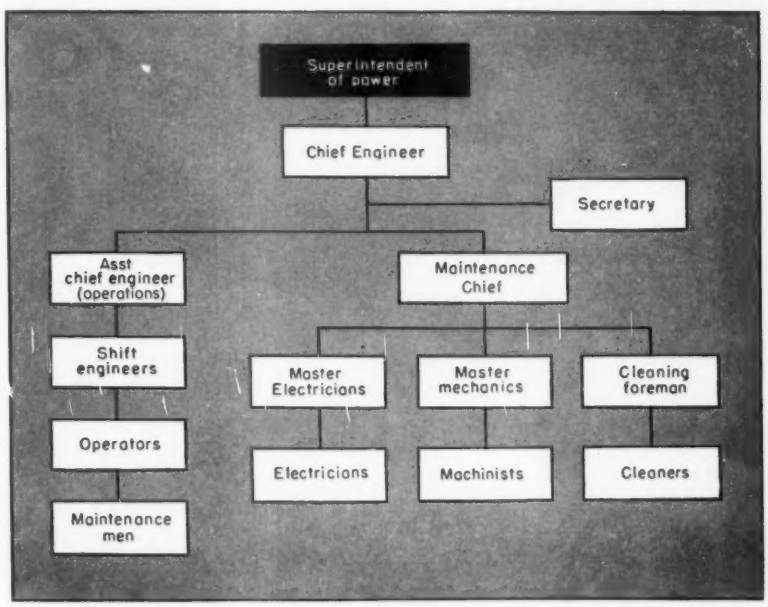
A good organization chart will be extremely helpful in *CC's* plant. It will answer many questions arising over lines of authority and the relationships between different departments and their duties in plant operation.

A J BREUGELMANS *New York, N. Y.*



USE A SETUP like that shown. It has worked well in many plants.

J W SMITHWICK *Washington, D. C.*



PLANT ENGINEER can supervise operation as shown in the accompanying diagram. All schedules originate in his office where the work of the power engineer, plant-design engineer and maintenance engineer is mapped out. Each of these men is responsible for his own department.

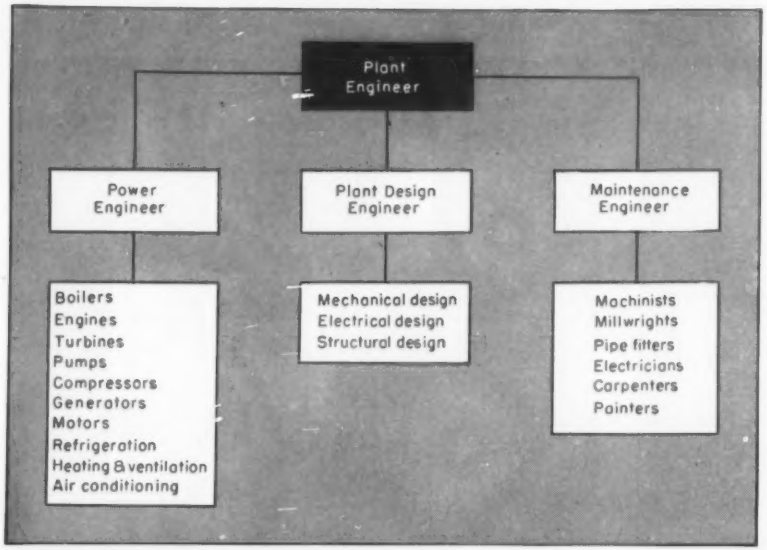
Of course, the number of personnel vary with plant size. The chart, p 132, can be altered to suit conditions.

H B WAYNE *Brooklyn, N. Y.*

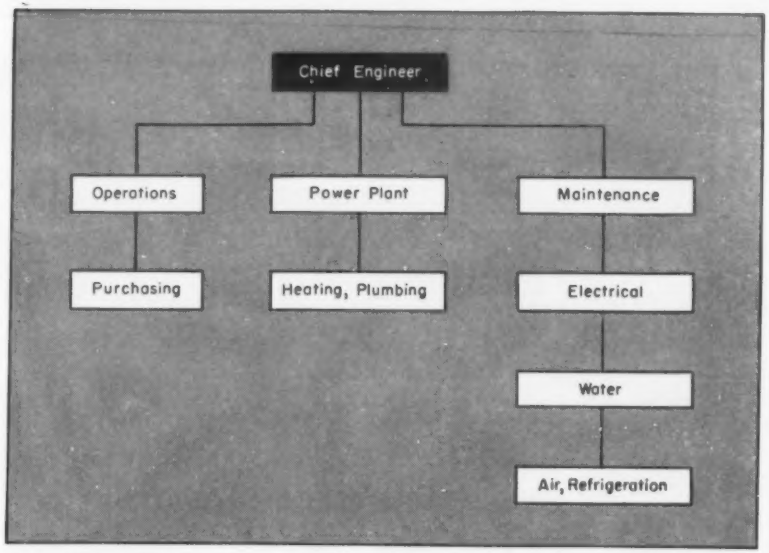
AVOID THE PITFALL of too many bosses in a plant organizational setup. But keep individual departments well separated so there is little overlapping of

(*Continued on page* 198)

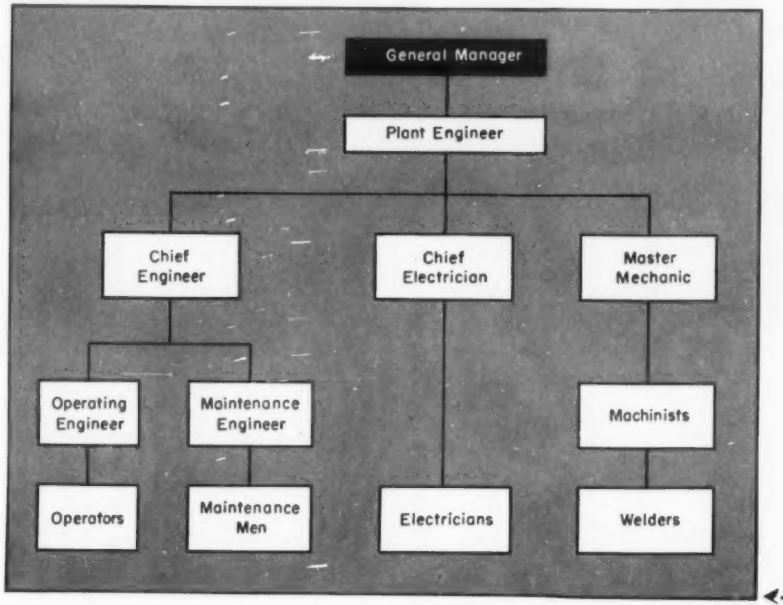
More PLANT PROBLEMS



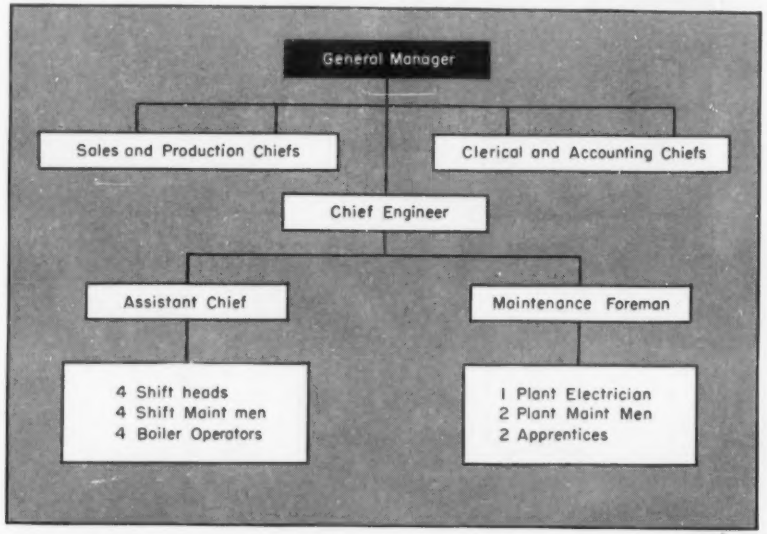
WAYNE divides plant operation into three major functions with each under one man



FITZPATRICK has a chief engineer in charge of operations, power and plant upkeep

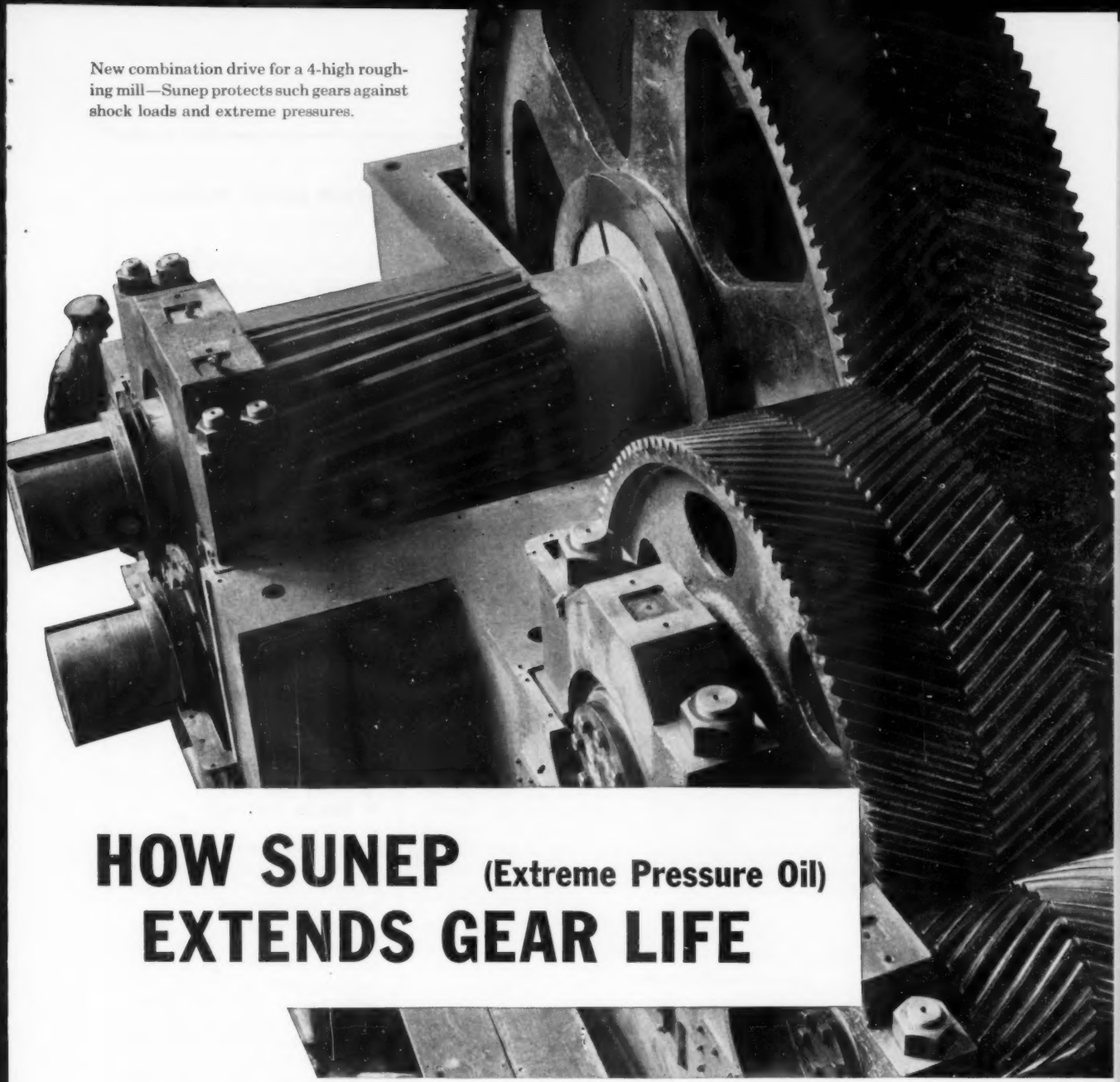


←**HOWARTER** has parallel responsibilities for chief engineer and chief electrician



HOLCOMBE shows how engineering and operating jobs can be set up in a typical plant

Begins on page 130



New combination drive for a 4-high roughing mill—Sunep protects such gears against shock loads and extreme pressures.

HOW SUNEP (Extreme Pressure Oil) EXTENDS GEAR LIFE

The advantage of running your machines at high speeds and under heavy loads can be quickly lost if your extreme pressure lubricants turn thick, lose film strength, or cause gears to corrode.

Sunep gives your gears better protection longer. Unlike many E.P. oils, Sunep is made from highly refined, premium grade oils skillfully blended with chemical additives that do not drop out during operation or in prolonged storage. This accounts for several rare user benefits: long life at extreme pressures; absence of corrosion—even on bronze; rust protection for steel parts; clean gears and bearings as a result of the oil's high stability.

Primarily a lubricant for enclosed gears, Sunep has proven to be highly effective on bearings and screws working under extreme pressures. Because of its exceptional clinging characteristics, Sunep guards against metal-to-metal contact during the early moments of machine operation after shutdown. FREE BULLETIN. Tells all about Sunep. Get your copy. Write Dept. P-8.

INDUSTRIAL PRODUCTS DEPARTMENT
SUN OIL COMPANY

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PHILADELPHIA 3, PA. • SUN OIL COMPANY LTD., TORONTO & MONTREAL

Refiners of famous High-Test Blue Sunoco Gasoline

More PLANT PROBLEMS

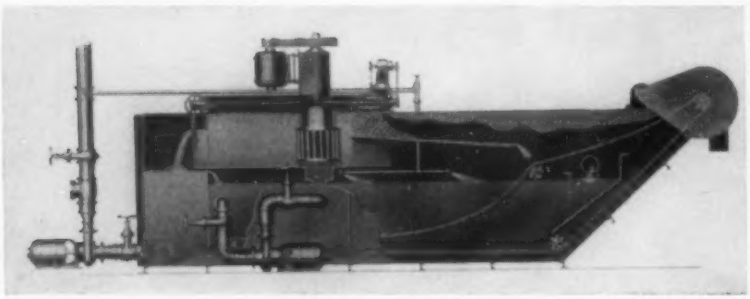
Begins on page 130

How can we protect coolant-oil pumps?

HERE ARE THE FACTS: **We have three 100-gpm centrifugal pumps for handling coolant oil in our metal-working shop. These pumps were installed three months ago and have been a constant source of trouble. Wear in casings, impellers, seals and wearing rings is excessive.**

How can we reduce this wear? Can the oil be treated before it reaches the pumps? What are good hookups? —*MV, May POWER*

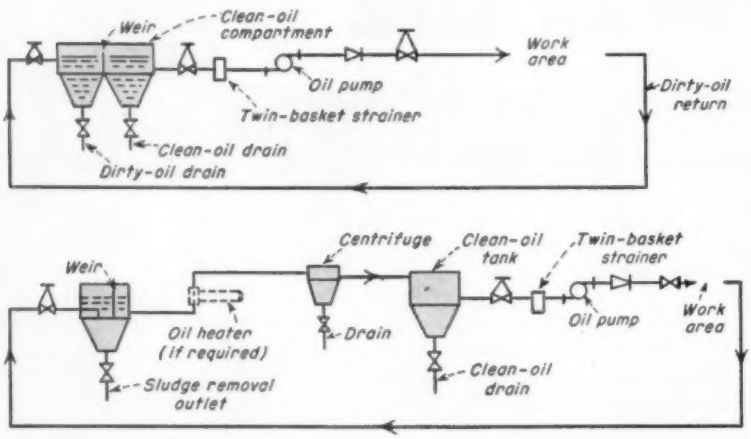
Here are the answers



USE STANDARD UNITS to settle and filter metal chips from the oil stream. Photo shows one typical unit that continuously removes chips, heavy solids and relatively fine solids.

Size of unit required depends on the settling rate. This is governed by the gravity of the solids and the viscosity of the liquid. These fix the retention period for a given rate of flow. Chain-driven flights expel the settled solids.

DON KELLAND *New York, N. Y.*



TOP SKETCH shows a hookup that is better than one using only strainers. It consists of a 2-compartment tank having hopper bottoms. Contaminated oil enters the dirty-oil section where the heavier particles settle out. Clean oil passes over the weir into the clean-oil compartment. This design may require piping larger than in the existing system because the friction losses are greater.

Lower sketch shows a better, but more costly system. It has a separate sludge-settling tank, a centrifuge and a clean-oil tank. If oil viscosity is too high, a preheater may be needed to permit the centrifuge to operate properly. This design offers maximum assurance of troublefree operation.

Be sure tank size is sufficient to al-

(*Continued on page* 208)

YOUR AUGUST PROBLEMS

1 Is corrugated piping still suitable?

I'm a senior staff engineer for a large consulting firm doing many steam-plant jobs. Recently we ran into some tough expansion problems and I suggested using corrugated piping to solve them easily and quickly.

The opposition to my ideas was not only strong—it was also heated. Yet my calculations show that this type of pipe often saves money and space without endangering the safety of personnel. And as far as appearance goes it can be insulated to look like any straight-wall pipe.

Why all this opposition? Does experience show that this type of piping is unsafe? What are good selling points I can use on my boss?—*MF*

2 Why do boiler loads swing?

We have three stoker-fired water-tube boilers fed by reciprocating pumps. The feed enters front header of each unit.

Our charts show the steam-header pressure is fairly constant at 120 psi, with a maximum variation of 18 psi. But each boiler flowmeter shows wide swings, usually on opposite cycles, with each unit alternately taking the load.

What causes this? The non-return valves do not seat during the load shifts. Gas temperature in first pass varies 300 to 400 F during the swings. How does this affect efficiency?—*AR*

Will you help readers who sent problems? Extra pay for photos, sketches.

BETZ • *A Great Name In Water Conditioning*

we're from Missouri...

. . . and for good reason!

Betz Water Conditioning Service is based on the policy that nothing is left to chance. There are no mere guesses or assumptions that conditions are satisfactory at a client's plant.

In addition to regular visits by Betz Engineers and daily water testing by plant personnel, we "double-check" results by means of more complete analyses in our own laboratories.

At regular intervals, water samples from important points throughout the plant system are secured by our engineers and forwarded to our modern laboratories. Here, experienced chemists analyze each sample until it literally breaks down and "admits the facts".

Such painstaking analyses often reveal conditions which may not be evident from plant control tests. It permits our Engineering Division to make corrective recommendations *well in advance*, thereby heading off any serious trouble which might develop. This, too, is *another* important part of Betz *completely-integrated* water conditioning service.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa.

In Canada: BETZ Laboratories Limited, Montreal 1.

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

ARGUMENTS

Want to start something? Like to have your say about any article in Power? This department invites all comments

What will solve the shortage of engineers?

College training is the only solution. Reader Cochrane's understanding of the shortage of engineers (p 144, April POWER) and the use of noncollege men as substitutes is dolorous, to say the least.

The virtuosity of a speaker does not make him a reliable preacher, although the quality is considered essential. Likewise, an intelligent layman with exiguous furbish cannot elicit the faith in judgments, even though specious, that can a laconic or succinct professional college-bred engineer.

I may note we are also short of doctors; will Cochrane consult the Butchers Local to see if they have some benignant meatcutters?

JAMES CATES *Corpus Christi, Texas*

We train noncollege men. I can back up Reader Cochrane's comment (April *Arguments*) about using noncollege men as engineers. Several of our key engineers here at Purolator Products, Inc, were originally taken from the shop, where their initiative and ingenuity marked them as above-average individuals.

Our chief service engineer is one of these; another shop selectee designed and installed all our test and laboratory equipment, and was the first head of our laboratory; still another is now one of our principal designers. These three men aggregate 65 years of service with our company, and we have never found their lack of formal education a handicap.

In addition, we have five laboratory and engineering employes who came to us while attending school, and have finished or are finishing their technical courses at night. One of them is head of our paper laboratory, another is assistant service manager, the others are very satisfactorily aiding our test program.

We trained all these men by putting them beside experienced employes until they became familiar with their jobs. Then their natural talents, stimulated by opportunity, let them forge ahead. Mark us down as firmly believing that training is a highly satisfactory substitute for formal education.

J P KOVACS, *vice-president Purolator Products, Inc, Rahway, N.J.*

You need two types of engineers. George Edwards recently brought up the question of whether graduates are necessary for all types of engineering work (page 172, Jan POWER).

In the Philippines (and perhaps in many other countries too) there are two groups of engineers: slide-rule and calloused-hand. The first group are college graduates; the second have grown old in their jobs of doctoring engines and machines, but carry no college degrees.

The college group often resort to slide rules to solve engineering problems. Calloused-hand men always grab a wrench, micrometers, tachometers or other tool. In my opinion, slide-rule men are best suited to engineering and sales departments, while calloused-hand men are very important for jobs in machine shop, power plant and field construction.

We could certainly produce useful and dependable engineers without submitting men to rigorous university life, but it is imperative to encourage learning mechanical engineering in universities. The dignity of that profession must be upheld. Both types of engineers are needed.

L B VILLARTA *Oroquieta, Philippines*

Should you test safety valves by popping them?

I SEE THAT Dusty Jennings says (May, *Practical Ideas*) that he tests his boiler safeties by popping them every day. But if a safety valve is popped by raising the stem, as Dusty mentions, the disk never seats right; manufacturers say this should never be done.

Some old marine engineers believed in popping valves daily by raising the steam pressure. But high-pressure valves have a way of leaking after they pop, so today this practice isn't prevalent either.

Can any reader tell me the best practice to follow? Do you pop safeties every day? Do you pop them at all? How often? If not, how do you know they'll work when they should?

STEVE EDWARDS *New Orleans, La.*

Recommends alternate solvents for cleaning

REGARDING THE QUESTION about solvents for ball bearings, May *Arguments*, we use solvents other than carbon tetrachloride and xylene.

For light cleaning, we find that pure grain alcohol or ether has excellent cleaning powers, and does not attack the precision balls. Most watchmakers and precision-instrument manufacturers use special washing and rinsing solutions.

For extremely grimy ball bearings from motors, we use No. 6 fuel oil. This readily removes carbon and oil deposits without harming bearing surfaces, and is much faster than carbon tetrachloride.

For extremely mild deposits on precision equipment, gears, cams, etc, a weak solution of a household detergent cleans perfectly.

L W FITZPATRICK *Jefferson City, Mo.*

Frowns on using carbon tetrachloride

PERHAPS THE FOLLOWING information about carbon tetrachloride as a cleaning solvent will help answer "Are solvents harmful?" (May *Arguments*).

Carbon tetrachloride has been frowned on for several reasons.

1. It evaporates quickly and tends to dry metal surfaces so completely that finely finished surface metals, like precision ball bearings, become subject to oxidation and rust, or even corrosion.

2. By the same token, it tends to dry out the preservative qualities in the covering materials for motor windings. It would cause dry cracking, breaking loose and would shorten the durability

(*Continued on page* 218)

Assembly Line Steam Trap Maintenance Saves Time and Money

It costs less to repair a group of traps before they all need it than to wait and repair one at a time

CHART I — COST OF LABOR FOR ONE TRAP

(assuming labor at $2.00 per hr.)

LABOR	MINUTES	COST
Get parts from store room	3	
Get tools	2	
From store room to trap	5	
Shut off steam	1	
Wait for trap to cool	5	
Remove cap and mechanism	2	
Replace Valve, Seat and Lever Assembly	4.5	
Remove old gasket and clean gasket surface	2	
Apply gasket dope	1	
Put on new gasket	1	
Install cap with mechanism	2	
Turn on steam	1	
Back to shop	5	
TOTAL PER TRAP	34.5 min.	$1.15
TOTAL COST OF LABOR FOR 8 TRAPS SERVICED INDIVIDUALLY	4 hr. 36 min.	$9.20

CHART II — COST OF LABOR FOR 8 TRAPS SERVICED AT ONE TIME

(assuming labor at $2.00 per hr.)

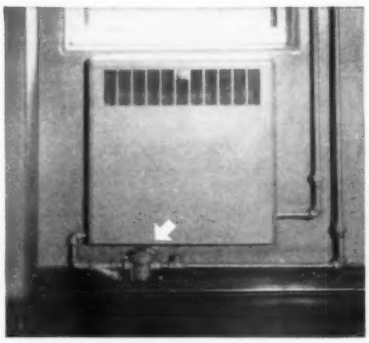
LABOR	MINUTES	COST
Get parts from storeroom	3	
Get tools	2	
From storeroom to trap	5	
Shut off steam	1	
Wait for traps to cool	5	
Remove caps and mechanisms	16	
Replace Valves, Seats and Lever Assemblies	36	
Remove old gaskets and clean gasket surfaces	16	
Apply gasket dope	8	
Put on new gaskets	8	
Install caps and mechanisms	16	
Turn on steam	1	
Back to shop	5	
TOTAL	2 hr. 6 min.	$4.20

ARMSTRONG traps do not demand constant attention, but when they do need repairs, maintenance money can be saved by replacing parts not only in the trap requiring immediate attention, but also, in the remaining traps of that series.

For example, assume eight traps were installed on an eight-coil dryer at the time of its installation. When one of these traps becomes worn to the point of needing replacement parts, there is a direct savings if *all* the traps receive new internal mechanisms at the same time.

Several traps draining the same machine, receive approximately the same wear. When one trap becomes worn to the extent of needing new internal parts the others will be soon to follow.

If the remaining traps have an average of 10% service life, before requiring repair, and the cost of a new valve, seat and lever assembly were approximately $4.00, replacement before absolutely necessary would involve a loss of $0.40 per trap. However, the labor cost involved will more than make up for this loss.



Armstrong No. 800 draining a convector at Globe Steel Tubes Company. Parts for this trap cost only 2¼ cents per year. Average trap life is 11 years.

Chart I shows that the cost of labor involved to service one trap is $1.15. Therefore, repair labor for eight traps serviced individually would cost approximately $9.20.

Chart II shows the cost of labor involved to service all eight traps at the same time. Here we find the labor cost is only $4.20. This leaves a labor profit of $5.00.

The loss of $0.40 per trap times the remaining seven traps is $2.80. Subtracting $2.80 from $5.00 leaves a profit of $2.20 gained by servicing all eight traps at the same time.

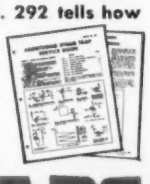
Thus, if traps are put on regular maintenance schedule and assembly-line servicing is employed, a very definite profit can be shown, plus the assurance of maximum operating economy at all times. Traps are kept in tip-top shape, eliminating steam or fuel waste that might occur if the trap is not caught before it goes bad.

Your local Armstrong Representative has parts in stock and valuable trap service knowledge to help you. Call him, or write:

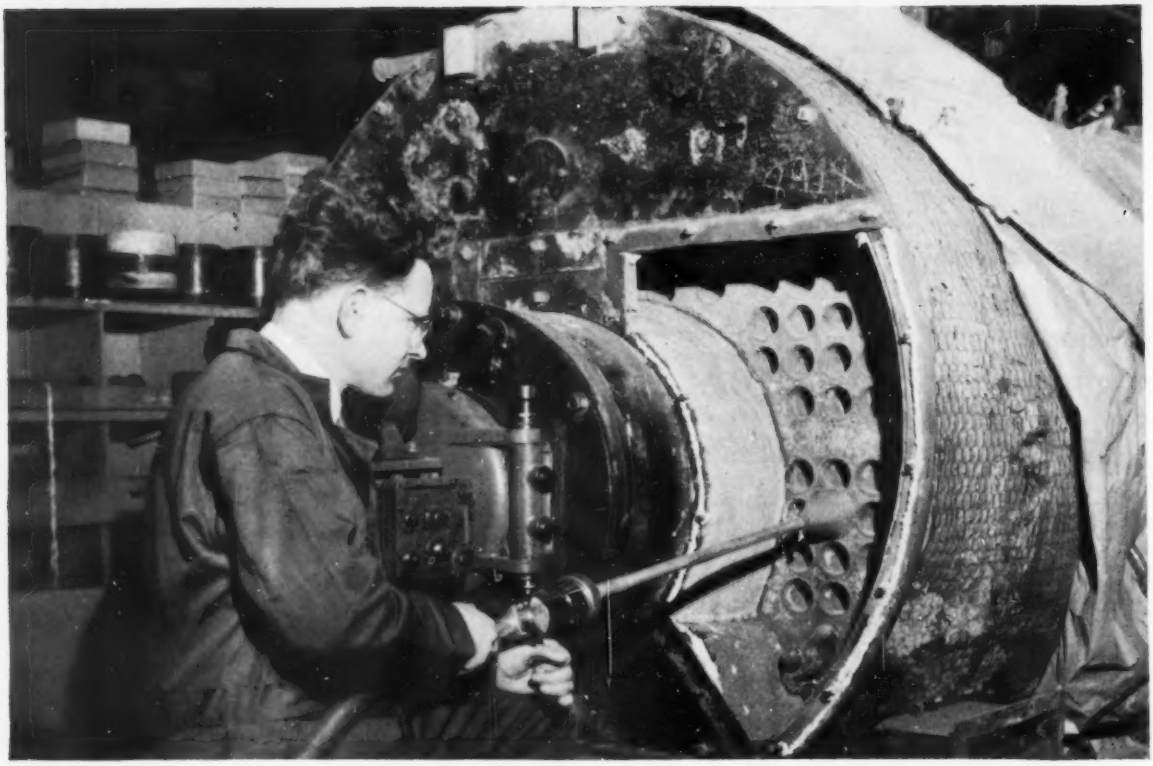
ARMSTRONG MACHINE WORKS
812 Maple Street • Three Rivers, Michigan

FREE MAINTENANCE BULLETINS—

Bulletin No. 239 is an 8-page trap Service Guide; Bulletin No. 292 tells how to save money on trap repairs. Send for them — no obligation.

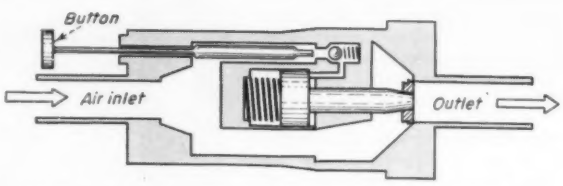


ARMSTRONG STEAM TRAPS



SOOT is removed from firetube boiler by L C Nesham, inventor. Percussion lance has blast-cone attachment to cover tube ends

HOW TO



VALVE opens-shuts automatically 1500 times a minute when button is pressed; 80 psi has cleaning effect of 1600 psi

Percussion-blast your tubes clean

► THIS LANCE works on an entirely new principle for cleaning tubes. When button is pressed, valve opens and shuts automatically 1500 times a minute. That converts the steady potential energy in air or steam line into a kinetic force applied to surface being cleaned, at rate of 1500 times a minute. An 80-psi air line can thus give cleaning effect of 1600-psi steady pressure, claims the manufacturer. This "live" pulsating force ups cleaning power about 20 to 1.

Amount of air or steam needed to operate lance is: minimum 20 cu ft of free air per minute at 100 psi, or 110 lb of steam per hour at 105 psi.

New tool is said to eliminate slow, laborious work with brushes and scrapers when cleaning soot, ash or clinkers from tube surfaces in boilers, economizers and air preheaters. Lance has few moving parts. In normal usage an annual overhaul is all the maintenance needed.

When cleaning firetube boilers, insert lance six inches into each tube. Press trigger. Three or four bursts will clean entire inner surface even if deposits are heavy, says the manufacturer. Tool weighs 5½ lb and is steady in action. It automatically switches off air or steam when plunger is released by operator, thus saving air or steam. Lance is said to clean a 300-tube waste-heat boiler in 30 min.

Soot, clinkers and most kinds of nesting on fire side of a watertube boiler can also be cleared by this high-frequency shock action of blasts, often without having to shut down boiler.

Many types of extensions, from a few inches to several feet in length are supplied so tool may be used for various jobs. Also handy for cleaning coal bunkers, large electric generators, as well as tubes of various kinds in plant.

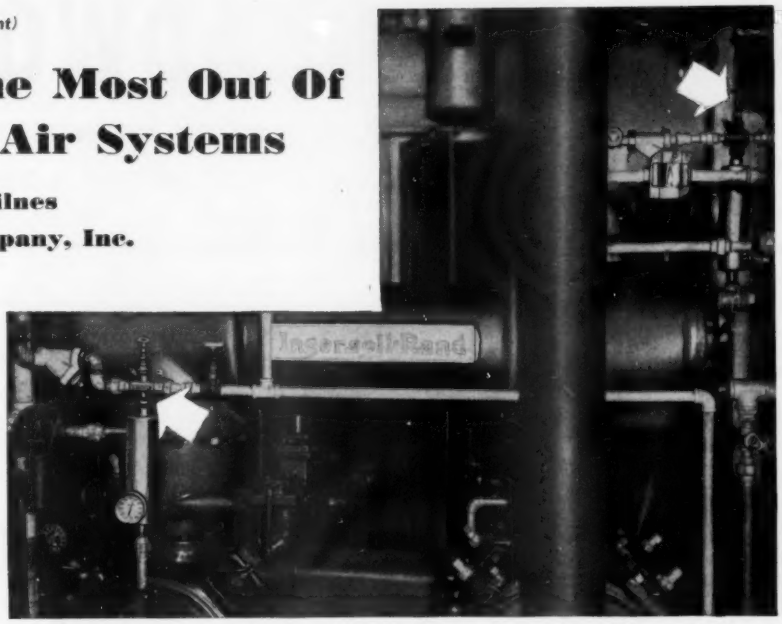
Courtesy, C F Carpenter,
P O Box 87, Allentown, Pa.

(Advertisement)

How To Get The Most Out Of Compressed Air Systems

A. Milnes

Sarco Company, Inc.



The replacement of hand controls by Sarco automatic cooling controls on this 2-stage Ingersoll-Rand compressor resulted in better lubrication, less condensate in air, and a considerable saving in cooling water.

THE practical place to measure the capacity of your compressed air system is where it counts the most—at your compressed air tools. From the time air is first drawn into the cylinder, many things can happen which will effectively reduce air pressure and limit compressor capacity. Following is a concise explanation of the major causes of reduced compressor capacity and the steps which can be taken to remedy them.

PROPER AIR INTAKE

Your compressor system can be fouled up before a pound of air has been compressed if the air intake has been improperly located. The air intake should be located where the atmosphere is clean, cool, free from corrosive chemical fumes, and dry to minimize condensation in the system.

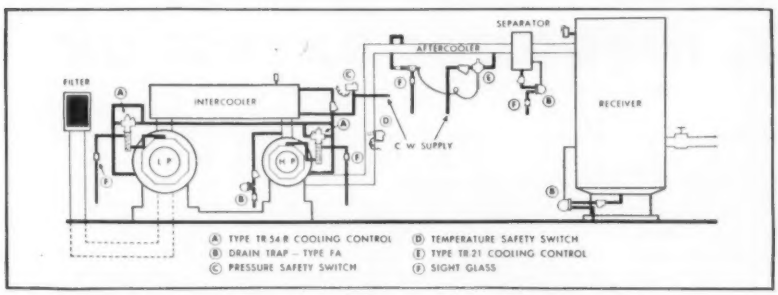
INTAKE PIPE DESIGN

A compressor can only operate at rated capacity if its air supply is unimpeded. Twisting, undersized pipes and dirty filters can effectively reduce air pressure at the compressor inlet. For example, a pressure loss of 2 psi due to friction in the intake pipe and filter will reduce the output of a 125 psi compressor by 7.5%. Check intake pipes and make sure they are short, of adequate size, and free of sharp bends.

AUTOMATIC COOLING CONTROL

One of the major causes of inefficient compressed air operation is unbalanced cooling. For example, overcooling wastes water, causes deterioration of compressor lubricant by condensation in cylinder head. On the other hand, undercooling reduces compressor capacity, may result in serious damage to cylinders, pistons, valves and seats.

To offset this, many compressor manufacturers such as Schramm, Ingersoll-Rand, and others install Sarco automatic cooling controls at the factory. These controls are self-modulating, insure optimum cooling effect with minimum water consumption regardless of load variation, changes in pressure and temperature of water supply.

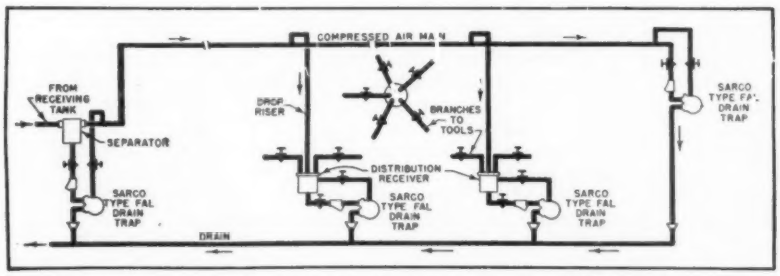


Sarco cooling controls are installed to regulate the water supply to cylinder jackets so that jacket discharge temperature is between 100-115° F.

CONDENSATE REMOVAL

If condensation is not kept to a minimum serious damage can result to tools, paint surfaces, molds, etc. Other results of excessive condensation in the system are water hammer and freezing of mains, receivers and tool exhausts.

To prevent this, well-designed compressed air systems usually have Sarco drain traps installed at the aftercooler, on separators, at receivers, and on low points in the lines to remove water as quickly as it collects.

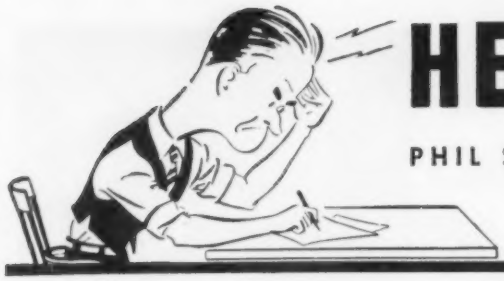


Drain traps at critical points in the distribution system effectively remove condensate — protect compressor equipment, tools, and work.

FREE TECHNICAL ADVICE

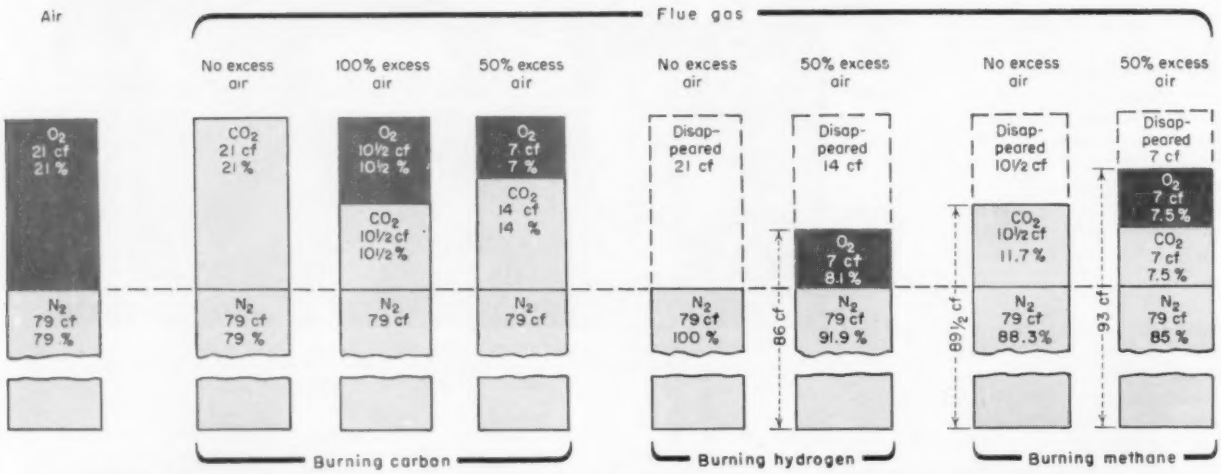
Sarco engineers have prepared a technical bulletin designed to pass on to compressed air users practical advice on how to improve air compressor operation. It also contains simple hook-ups of Sarco cooling controls and drain traps.

This bulletin may be obtained without obligation by writing the Sarco Company, Inc., Empire State Building, N.Y. 1, N.Y. Also represented in principal cities.



HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH



BURNING PURE CARBON, 100 cu ft air, gives 100 cu ft flue gas. $CO_2 + O_2 =$ 21%. Percent excess air thus becomes $100 \times O_2 \div CO_2$

BURNING PURE HYDROGEN, 100 cu ft air, gives down to minimum of 79 cu ft. Volume loss is oxygen and hydrogen combining to water

IN BURNING METHANE each volume of oxygen combining produces half as much volume of CO_2. So the net volume loss equals CO_2 volume

Combustion Facts-6:

How CO_2 measures excess air

► ENGINEERS ANALYZE stack gases for CO_2 percentage (by volume) as an indirect measure of excess air. A certain amount of air is chemically necessary to burn a given fuel. Because of imperfections in furnaces some excess over this is always needed. Using air beyond that point is wasteful since this unused air is discharged hot up the stack—a waste of part of the heat in the fuel.

The CO_2 in flue gas comes from the carbon in the fuel. The combustible in coal is mostly carbon along with some hydrogen. Fuel oil has more carbon, natural gas still more.

Let's see how CO_2 percentage is related to excess air for pure carbon, and then for a fuel containing hydrogen:

The examples pictured are worked out for simplicity on the assumption that air, by volume, is 21% oxygen (O_2) and 79% nitrogen (N_2). The exact figure is 20.7% oxygen. In each chart we start with 100 cu ft of air containing 21 cu ft of oxygen. In every case the 79 cu ft of nitrogen go through unchanged.

Now look at the left chart for pure carbon. Whatever part of the oxygen actually burns with carbon produces an equal volume of CO_2. This gives figures shown for no excess air, for 100% excess, for 50% excess.

Note this simple rule for excess air when fuel contains no hydrogen: Subtract CO_2 percentage from 21 (or, better, 20.7) to get oxygen. Oxygen times 100, divided by CO_2 is percentage of excess air. For example, if CO_2 is 14%, oxygen is $21 - 14 = 7\%$, and excess air is $100 \times 7 \div 14 = 50\%$.

Burning pure hydrogen, (*center chart*) gives no CO_2, only water. This water condenses and does not show up in the gas analysis. So all oxygen that burns with hydrogen is a net volume shrinkage. Take the case of hydrogen burned with 50% excess air. Here 14 cu ft of oxygen disappear, so the 100 cu ft of air supplied shrinks to 86 cu ft of flue gas containing 7 cu ft of unburned oxygen. Then the oxygen percentage is $7 \div 86 = 8.1\%$.

This shrinkage from hydrogen burning is the cause of confusion in interpreting the CO_2 reading for fuels containing hydrogen, as in the right-hand chart for methane (CH_4), chief constitutent of natural gas.

When you burn methane each volume of oxygen consumed produces half a volume of CO_2. The other half burns to water and so disappears as volume. With this relationship you can work out the percentages as given. Note that 50% excess air corresponds to 14% CO_2 for carbon, but only 7.5% for methane. In general, high hydrogen-fuels always show a lower CO_2 for the same excess air.

Trim costs with this hook-up for valve-killing corrosive services

Stainless Steel PLUS Jenkins Quality

To end high valve mortality from most corrosive liquids, and to control fluids that must be kept free from contamination or discoloration, stainless steel is the right metal. But it takes more than metal to make a valve. For dependable performance, you need the two-way hookup — Stainless Steel *and* Jenkins time-proved Valve Engineering.

With the increased demand for processing equipment that resists corrosion, more and more Stainless Steel Valves have been added to the Jenkins line. It now includes types, designs, sizes and alloys to meet practically all industrial needs.

Let the famous Diamond trade-mark be your guide when you choose valves of stainless steel. As on *any* Jenkins Valve, it means *extra value* . . . longer, trouble-free service life.

NEW BOOKLET describes the wide range of types, sizes, pressures, and alloys available in Jenkins Stainless Steel Valves, with diagrams and dimensions. Includes description of alloys, helpful information on selection, and survey forms. Ask for Form 200. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

SINCE 1864 TRADE JENKINS MARK

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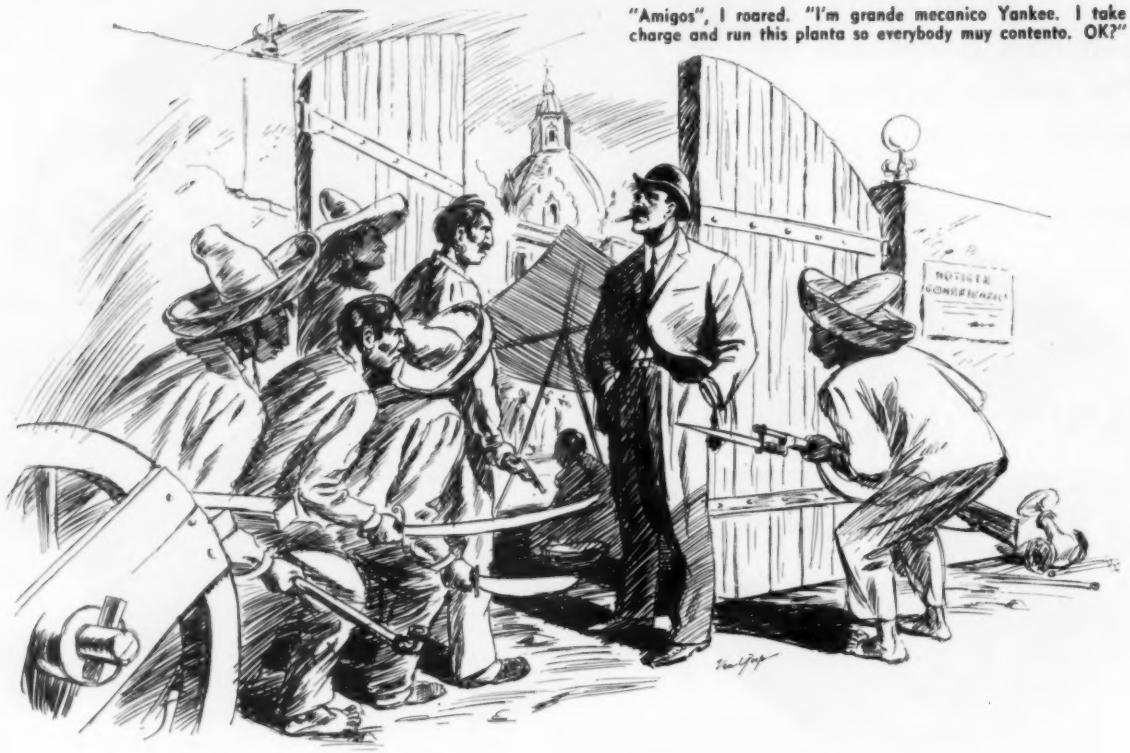
SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS EVERYWHERE



"Amigos", I roared. "I'm grande mecanico Yankee. I take charge and run this planta so everybody muy contento. OK?"

Mecanico Yankee en una planta electrica

► FLASH—An exclusive club in Texas now has a Bent Propeller Bar where top-level engineers get together. The bar was named in honor of the hangout of Marmaduke Surfaceblow, Esq, consulting engineer extraordinary. We have already mailed the club a large autographed portrait of Marmy so he can keep a weather eye on the members as they line the bar.

We also have reason to believe that some engineering societies will follow suit by naming their bars the Bent Propeller. In each case we'll send a large 8x10 autographed portrait of Marmy to grace their wall. We feel his presence will constantly remind the distinguished members not to make jackasses of themselves after the 15th or so martini, and to live up to the high engineering ideals that Marmy stands for.

Soon as I heard about that bar down South, I dialed Hells Kitchen 2-1876, then held the receiver about two feet from my ear.

"HEAVE AWAY," roared that familiar foghorn voice at the other end, shattering the quietness of our office like a blast from a ruptured steam line.

After I "heaved away" by informing the tough old sea dog about that bar, he roared, "Bilgewater on Texas bars, I'll tell you about the time I pulled a fast deal and made a windfall down in Central America."

I listened and took down his story for posterity. Here it is:

"Back in 1929, Bedlam and I were on the freighter *SS Congo* running to the African Gold Coast," bellowed Marmy, in his barroom baritone.

"One evening while lubricating our bearings at the old Absinthe House in New Orleans, a stranger hove over to our table.

" 'I'm Bill Pender, agent for the Central American Utilities Corp,' he announced, handing me his card. 'My firm has power plants in Costa Blanco and I'm looking for two tough engineers to do a little job for us below the Rio Grande.'

" 'What course you steering and what's your destination?' I asked, sizing up the throw of his crank.

" 'I want you to take over a large electric-generating station that was seized by the local Communist Sindicato down in Porto Bello. There's $25,000 in it if you deliver,' he explained quickly. 'But first you should know that the former plant superintendent is in a hospital right now with a bullet in his shoulder.'

" 'Bullets don't scare me and I'll deliver, Bill, so let's have a chart of that voyage before we set sail. And fork over $2000 just to keep things shipshape,' I told him. 'Then Bedlam and I'll square away and head south on the next ship.' After sealing that agreement with hand shakes and emptying a bottle of Sandpaper Gin, we shoved off for some shuteye.

"Next morning we paid off the *Congo*, signed papers at Bill's office and stowed away the retainer money. Bill made out papers showing we represented the American owners and that we were to take over the property. He told us that Governor Ramon Juigalpa had steered his state of Porto Bello into the Communist camp. Under the Red bosses, anyone could form 'sindicatos' and take over a business. And the new skipper didn't have to be qualified to run the firm, so long as he was a Red.

"A week later Bedlam and I hit the beach at San Carlos, Costa Blanco. We checked in at the old supintendent's villa. It was a large estate with acres of ground and as shipshape as a Bedford whaling captain's home. We had a Jap

(*Continued on page* 214)

Forest of Facts on Nalco® RECIRCULATING WATER TREATMENT

NALCO Laboratories' continuous research program has gathered this forest of facts about protecting recirculating water systems. In the search for the most effective *and economical* formula, the metal rods shown have been rotated in all types of recirculating waters and treating chemicals. Results pointed the way to a group of Nalco Treatments which assure users against scale and corrosion in virtually any recirculating waters. For details on Nalco Treatment to fit your particular system, call your Nalco Representative, or write direct.

Test rod from water treated with the Nalco 82 Method shows protective film and freedom from any scaling or corrosive attack.

THE Nalco 82 METHOD MAY BE THE ANSWER FOR YOU

The Nalco 82 Method is particularly suitable for scale and corrosion control in recirculating water systems which fall within the characteristic limits given here. Check them to see if your system should have Nalco 82 Treatment:

- Equipment to be protected contains steel and/or brass.
- Hardness of makeup water is more than 50 ppm; and sulphates and chlorides, as sodium salts, are less than 150 ppm.
- Calcium hardness of makeup can be as much as 500 ppm.
- Silica content of makeup water up to 50 ppm.
- Total alkalinity of makeup more than 40 ppm.
- Recirculation rates between 100 and 100,000 g.p.m.
- Where non-toxic waste water is required.

Act today to get the certain, low-cost protection of The Nalco System. Full data on Nalco 82 in free Bulletin 68.

NATIONAL ALUMINATE CORPORATION
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THE Nalco SYSTEM . . . Serving Industry through Practical Applied Science

Fuel Economy for EVERY SIZE OF

Fuel economy is just as important for the small or medium-sized boiler plant as it is for the large plant. For any number or size of boilers, at any steam pressure and temperature, Hagan Automatic Combustion Control and Ring Balance Instruments Systems are designed to attain the maximum economy of fuel.

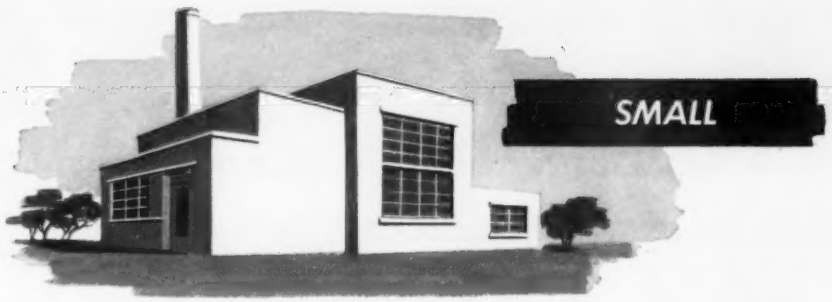
The systems used in smaller plants need not be as elaborate as in the larger plants, but all must meet the highest standards of performance.

Whether simple or more extensive, every Hagan system is the assembly of accurate and dependable units in a coordinated system requiring minimum maintenance. The fuel savings normally pay for the system within the first year. Subsequent savings are clear profit.

Hagan engineers will be glad to show you how Hagan Automatic Combustion Control and Ring Balance Instruments can be fitted to your exact needs, and can save your fuel dollars.

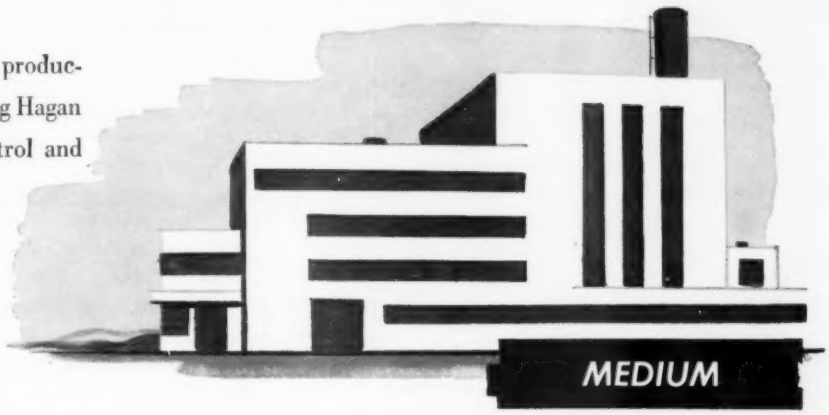
HAGAN Automatic Combustion Control

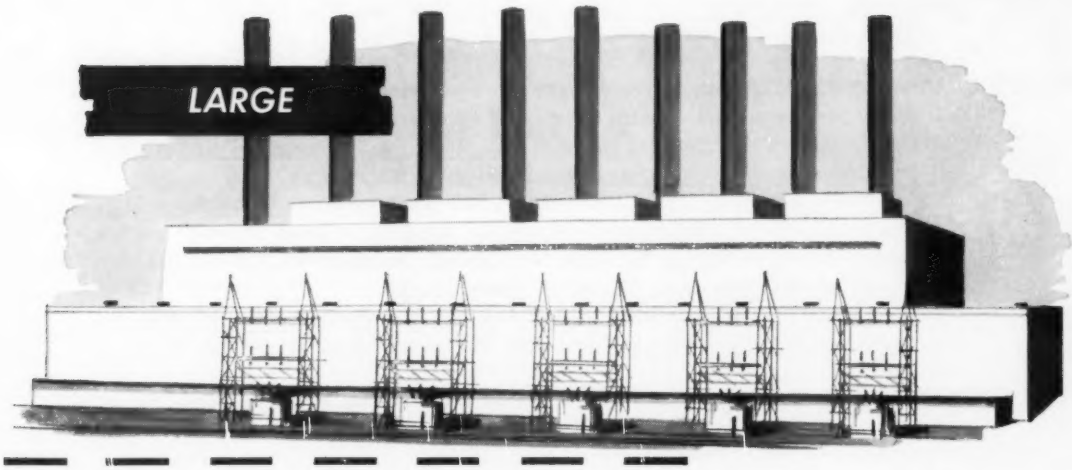
HAGAN Ring Balance Instruments



BOILER PLANT

Save fuel—and keep steam production costs down—by installing Hagan Automatic Combustion Control and Ring Balance Instruments in your boiler plant.





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Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems Control Systems for Automatic and Aeronautical Testing Facilities

Speaking of power

personal slants on doings of interest to power men—some significant, some just odd

Russian power headaches are painful and plentiful if we're to judge by reports in the Soviet newspapers, monitored for us. Izvestia puts the finger on top-echelon planners, blames their inefficiency for delays in completing the 2,000,000-kw Kuibyshev hydroelectric project.

Not to be outdone, Pravda charges that one of Russia's largest makers of electrical machinery has turned out a number of defective generators. And they recently called attention to widespread waste and duplication in electricity supply of many cities. At Zaleshchiki, says Pravda, eight plants operating at 10 to 20% capacity all have their own power lines, "which often run parallel and interfere with one another".

Despite this seeming luxuriance of supply, Zaleshchiki's needs aren't being met and preparations are being made to build another power plant.

Dig that big scoop! We mean, of course, the 60-cu-yd bucket of the new Marion power shovel ordered for the Hanna strip mines. It seems only yesterday I had my picture taken, along with a bunch of wide-eyed visitors, in a 33-cu-yd bucket that seemed to cover all outdoors. Now, only a little more than ten years later, they're hacking at the overburden with shovels nearly twice as big.

Hot cooling water isn't any better for condensers in Australia than it is here. Big extensions at the brown-coal-burning Yallourn Power Station pushed up water temperature in the Latrobe River some 30 F. The answer will be the largest cooling tower "down under"—to be built by R Werner & Co Pty Ltd, to the designs of our old friends the Marley Co of Kansas City.

March of the pipeliners brings natural gas to new areas, reinforces the supply in those already served. Pacific Northwest Pipeline Corp just won authorization for a line from the San Juan Basin of New Mexico and Colorado to market areas in Utah, Wyoming, Idaho, Oregon and Washington.

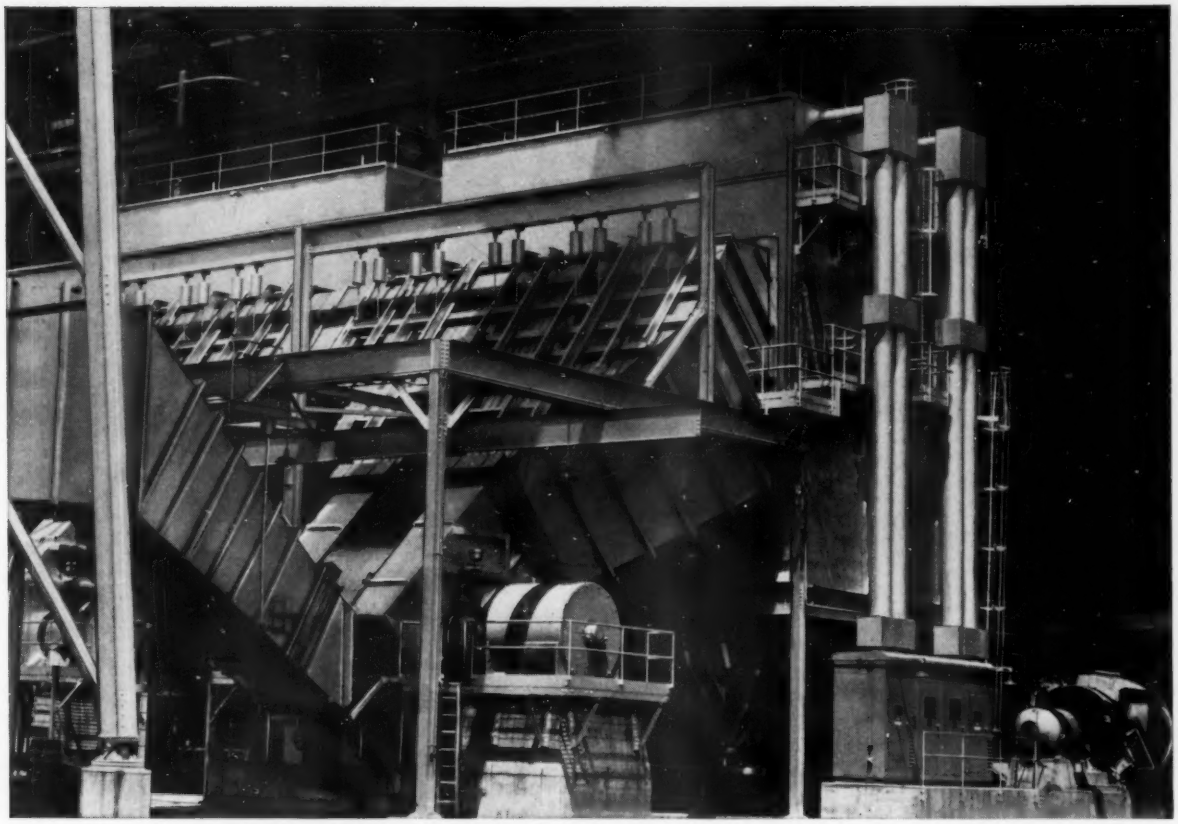
The East Coast is in the picture, too. What promises to be the world's largest pipeline (1425 miles of 24 and 26-in. pipe) is being planned and has received government OK for rapid tax writeoff. Rated at 500,000 bbl per day, it will run from Beaumont, Texas, to Newark, N. J.

In case you're wondering, proved reserves of natural gas in 1953 were estimated at 200 trillion cu ft, more than 20 years' supply at present usage.

How many men for war agencies? A report of the National Planning Assn recommends recruiting and training 5000 industrial executives to ready them for key spots in emergency war agencies. Office of Defense Mobilization is thinking in terms of a reserve of about 300 civilians.

Whether 300 or 5000, anyone who has watched the formative fumbles in past mobilization programs knows that a cadre of trained men ready to step into top jobs would make a whale of a difference in the industrial effort that would be needed in any future crisis.

Lou Rowley



For this Midwest power station, Westinghouse induced draft (center) and forced draft (right) fans move a total of 92,500,000 cubic feet of air and gas every hour, every day.

8 All-Weather Westinghouse Fans Supply Mechanical Draft to Meramec Station of Union Electric

Air-cooled bearings, welded steel construction resist elements

Eight Westinghouse Turbovane mechanical draft fans with vane control supply draft to the two boilers of the Meramec Station of Union Electric Company located in St. Louis, Mo. Installed outdoors where they are exposed to the varying elements, these fans perform their part of a vital power-generating job with only routine maintenance.

Four of these fans are Turbovane forced-draft type arranged double width, double inlet. The other four are Turbovane induced-draft fans with radial-tipped blades and erosion-resistant wheels. Vane control on all fans allows instantaneous regulation of air volumes to meet changing steam demands.

For power generation—or for any other air handling job—check on Westinghouse-Sturtevant apparatus today. Let the industry's most complete air handling line *put air to work* for you—efficiently, economically. Call the Westinghouse-Sturtevant specialists located in your area or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

Located at the heart of power generation at Meramec, four Westinghouse forced draft fans supply 150,000 cfm each, at 11.3 inches water gauge while operating at 1180 rpm. These are teamed with four Westinghouse induced draft fans handling 235,500 cfm each, at 277°F and 17.1 inches water gauge while operating at 700 rpm.

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE... IF IT'S Westinghouse

J-80417

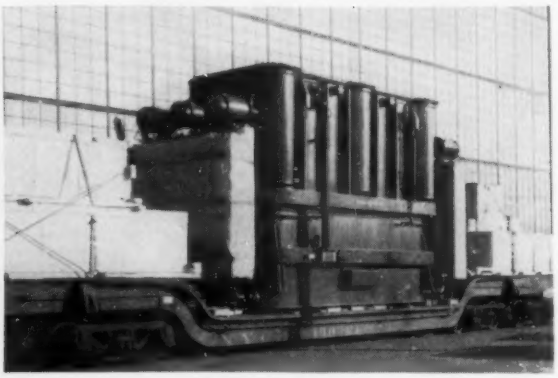
READER SERVICE SECTION

POWER NEWS ____ 148
TECHNICAL BRIEFS ____ 150
PLANT EQUIPMENT NEWS ____ 154
NEW FREE BULLETINS ____ 163

Largest turbine blades

► FORTY-INCH EXHAUST BLADES, the longest in production today, are the outstanding feature of this 92-ton low-pressure turbine spindle. Designed by Allis-Chalmers for a 125,000-kw cross-compound steam turbine, the unit will operate at 1800 rpm and is double flow.

Two new power stations are already using double-flow 40-in. exhaust blade spindles, operating on conventional and close-coupled cross-compound units for 1 in. and ½ in. exhaust pressure. The latter is the lowest pressure used today.



Complete transformer setup on one railroad car

► "PACKAGED" TRANSFORMER installations are now possible. As pictured above, a 120,000 kva transformer, complete with crated accessories, is placed on a single flat car and arrives at its destination ready for installation.

Built by General Electric, the above plant is destined for the Public Service Co of Indiana. Rated at from 240,000 GrY volts to 13,200 volts, the unit is forced-oil-air cooled and when completely assembled, including oil, weighs 163 tons. Traditional transformer design was by-passed to comply with the railroad car's dimensions and clearances, by mounting the unit coolers on the ends of the tank rather than the sides.

GE engineers say shipping transformer upright in its own tank saves field installation time, the amount depending on local conditions. In this shipment, all unit coolers were left in place, saving an extra day of installation time.

For Coming Events see page 222

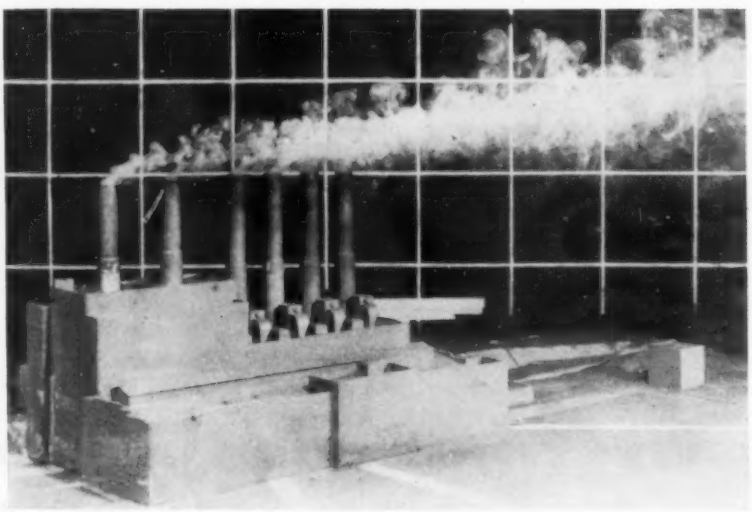
Study air pollution in NYU wind tunnel

► SCIENTISTS at New York University successfully use wind tunnel experiments to study air pollution caused by power plant exhaust stacks. By carefully reproducing wind, temperature and gas-air mixtures, a research group headed by Dr Gordon H Strom and James Halitsky closely approximates actual power plant smoke problems.

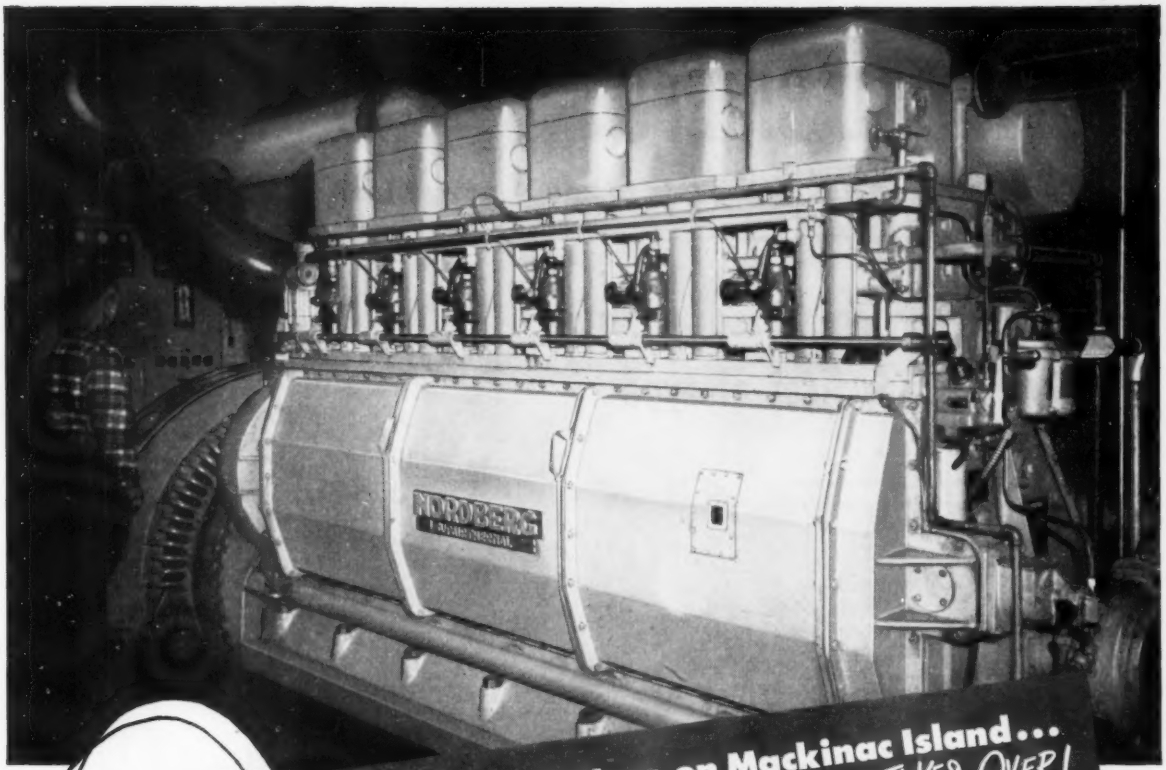
Strom is head of NYU's aeronautical engineering department and Halitsky is a member of the university's research division.

The group uses a scale model plant with details of surrounding terrain mounted in a 3½x7 ft wind tunnel. A light-beam photocell combination detects smoke the instant it touches the tunnel floor. The combination is sensitive

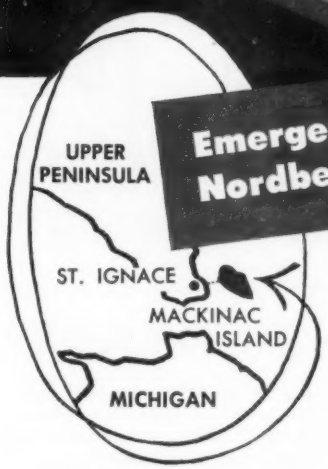
(*Continued on page* 234)



MODEL of the Avon Lake power plant mounted in a wind tunnel at New York University's School of Engineering permits study of wind's effect on plant's gas wastes



Emergency power failure on Mackinac Island... Nordberg SUPAIRTHERMAL Diesel TAKES OVER!



● Electric service reaches Mackinac Island via submarine cable from the Michigan Upper Peninsula. When this cable was damaged recently, main power on the Island was interrupted about eight days, while special equipment was moved in to raise the cable and splice the break. According to the Edison Sault Electric Company, *"If the new Nordberg standby engine had not been immediately available . . . it is questionable whether or not service could have been maintained . . ."*

MACKINAC ISLAND, famous northern Michigan resort area, is served by the Edison Sault Electric Company, progressive utility with headquarters in Sault Ste. Marie, Mich. When unusual circumstances caused a temporary main power failure recently, the job of supplying the necessary electric power to Mackinac Island residents was immediately assigned to a new Nordberg 1200 hp *SUPAIRTHERMAL* Diesel Generating Unit.

Installed on Mackinac Island for emergency, as well as "peaking" service during the heavy tourist season, the new 800 kw Nordberg Diesel "took over" the full demand for about eight days, while the primary power line was being repaired. This installation is a good example of Nordberg engines serving the country's utilities, for both standby and main power supply. The next time you have a power problem, think of *Nordberg* . . . builder of America's largest line of heavy duty engines from 10 to over 10,000 hp. *Nordberg Mfg. Co., Milwaukee, Wis.*

NORDBERG

DIESEL • DUAFUEL® AND SPARK-FIRED GAS ENGINES

P254

TECHNICAL BRIEFS

Latest engineering developments for busy power men

8 Digests for you on:
CYLINDER DESIGN
COOLING TOWERS
POWER DISTRIBUTION

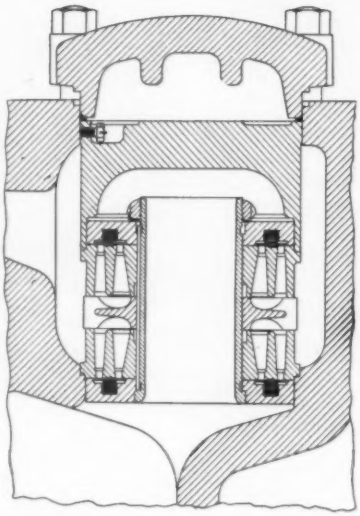
Gas-line compressor-cylinder valves are first of type

Trends in gas-transmission compressor-cylinder design at Cooper-Bessemer. *By W Hartwick, The Cooper-Bessemer Corporation.*

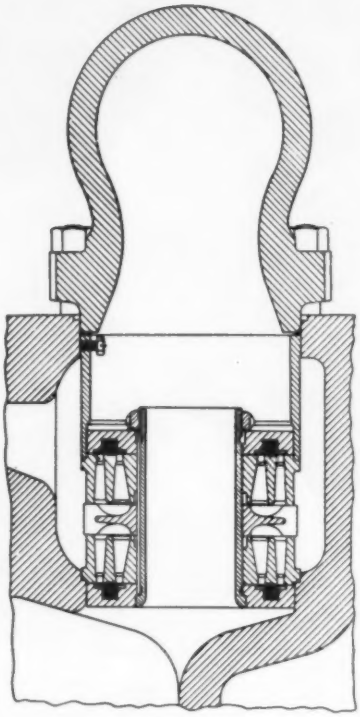
In recent years the economics of natural-gas transmission lines have dictated changes in the operating conditions of booster stations. These include a trend toward lower compression ratios for present and proposed stations on existing lines and toward lower ratios and higher operating pressures for stations on projected lines.

Higher horsepower-per-unit gas engines reduce first and operating costs of compressor stations. In addition, the rising cost of gas in the field has increased the importance of obtaining the utmost in compression efficiency to minimize the amount of gas needed for engine fuel.

Changes in operating conditions and the desire for increased efficiencies brought about the development of compressor cylinders designed specifically for gas pipeline service. Fig. 1 and 2 show typical examples of recent designs of compressor cylinder valves. *ASME paper No. 54-OGP-1.*



1 Double valve is fitted with minimum clearance cages for a specific job



2 This double valve with open cage and enlarged cap gives greater clearance

Presenting the new AIEE-ASME speed-governing specifications for internal combustion engine-generator units. *By W L H Doyle, Caterpillar Tractor Co.*

This paper reviews limitations found in speed-governing specifications currently employed in purchasing engine-generator units. The extensive use of the ambiguous terms found in these specifications points to the great need for a uniform terminology applying to engine speed control.

Frequently, some of the performances specified are unattainable. Costly disagreements often result from differences in interpretations of current specification clauses because of the terminology and the differences in procedures that may be used for evaluating actual performance.

To meet these conditions the Joint AIEE-ASME Subcommittee after several years of deliberations now introduces a uniform terminology together with three separate standard purchase-type speed-governing specifications.

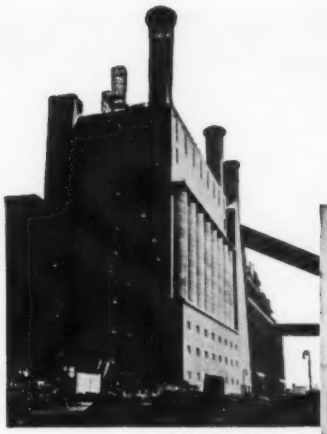
The terminology and specifications are expressed in terms of measurable performances which can be determined under reproducible operating conditions either at the time of final acceptance or at other times for purposes of development. A proposed industry-wide cooperative program to expedite the early general usage of these new standards is suggested. This includes the development of an appropriate test procedure. *ASME paper No. 54-OGP-6.*

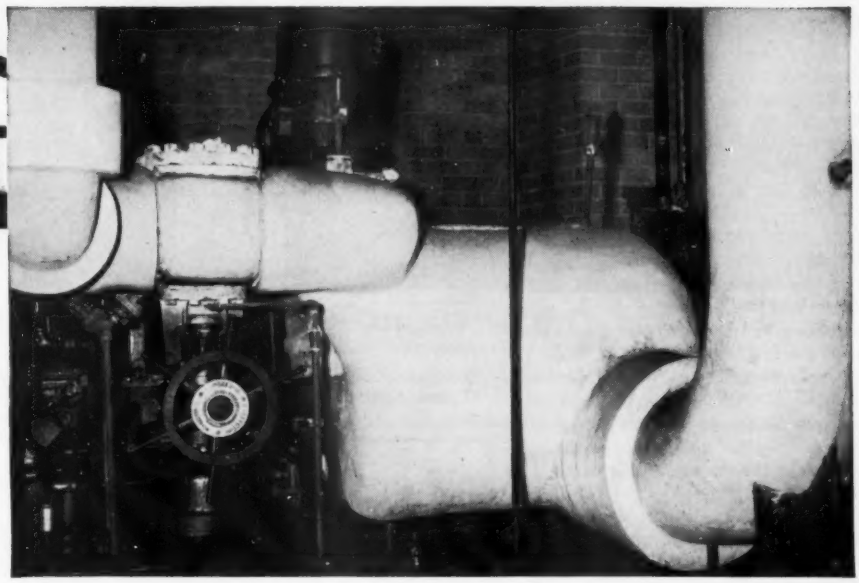
Turbocharging two-stroke gas engines. *By C A Chamberlain and G H Bollman, Clark Brothers Company.*

Why should a 2-cycle gas engine be turbocharged? It is already recognized as simple to operate, compact, reliable and efficient. What else does it need to further its place in its field?

Lower fuel consumption and higher power output have always been demanded of the engine, without sacrificing any of its advantages. The 2-cycle gas engine must positively pump the air it uses for combustion and scavenging. The crankshaft power required to pump this air on nonturbocharged engines is a significant part of the total developed crankshaft power and the total engine fuel consumption. Turbocharging is a practical means of relieving the engine crankshaft of this duty. At the same time it makes possible an increase in mean effective pressure.

The solution chosen by this company is both interesting and practical. Engine bhp is increased 33% over that of a noncharged cylinder of the same dimensions. Steps in the design precedure are discussed in the paper. *ASME paper No. 54-OGP-7.*





(Above) View of recently completed annex to Consolidated Edison's power plant . . . another link in their gigantic expansion program. **(Right)** Close-up of J-M 85% Magnesia Insulation on boiler feed lines. It was expertly installed by the Asbestos Construction Company, Inc., an outstanding J-M Insulation Contractor.

CON EDISON SPECIFIES J-M 85% MAGNESIA PIPE INSULATION FOR MAXIMUM FUEL SAVINGS

Like all materials that went into the new power plant addition of New York's leading gas and electric supplier . . . the pipe insulation had to be the *best*. That's why Consolidated Edison Co. specified J-M 85% Magnesia . . . industry's No. 1 insulation for many decades and *still* the leader in its class.

J-M 85% Magnesia is the leading insulation on the market for temperatures up to 600F. It is bonded with asbestos fibers. This rugged insulation will not distort regardless of the length of time it stays in service. J-M 85% Magnesia fits snug and stays put. Heat savings, therefore, remain constant for the life of the equipment on which this insulation is applied.

For temperatures over 600F, J-M 85% Magnesia is used in combination with Superex*, a J-M insulation for service to 1900F. This double-layer construction, known as Superex Combination, eliminates through joints and protects the jacket against scorching. It also utilizes the higher heat resistance of Superex next to the hot surface, and the greater insulating value of J-M 85% Magnesia for the outer layer.

Experience has proved that all insulations must be properly installed to pay maximum dividends. That's why Johns-Manville offers industry the services of experienced insulation engineers and installation contractors who have made a career of solving complex insulation problems. From coast to coast, these engineers and the contractor's highly skilled mechanics stand ready to combine their talents and give you an insulation job that will more than pay off your initial investment with maximum fuel savings through the years.

When you face your next insulating problem . . . remember that Johns-Manville is "Insulation Headquarters." Consult your near-by J-M Insulation Contractor . . . or write direct to Johns-Manville, Box 60, New York 16, New York. In Canada, write 199 Bay Street, Toronto 1, Ontario.

*Reg. U.S. Pat. Off.

Skilled Applicators on the team of a J-M Insulation Contractor applying J-M 85% Magnesia to pipelines. Located throughout the nation, these contractors have had years of experience handling all types of installations. They know J-M 85% Magnesia and other J-M insulations as *quality* products, and take pride in applying them properly. Result: an insulation job that pays dividends through the years in maximum fuel savings.

Johns-Manville *FIRST IN* INSULATION

MATERIALS ENGINEERING • APPLICATION

More TECHNICAL BRIEFS

Begins on page 150

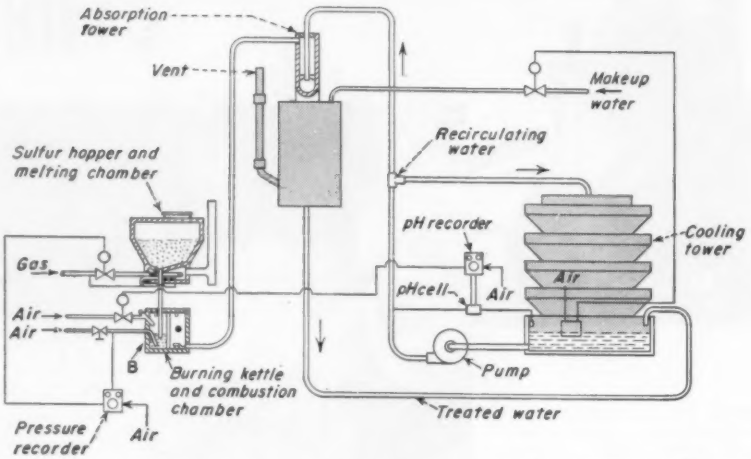
Cooling towers

The alleviation of cooling-water problems—use of automatic sulfur-burning equipment. *By J T Russell, Panhandle Eastern Pipe Line Co.*

This paper describes a fully automatic installation for treating water circulated through cooling towers. It requires only weekly tests for supervising treatment, and has reduced chemical costs 50 to 75% below former treatments.

Only two treating chemicals are used —sulfur and a corrosion inhibitor. Sulfur is burned in a specially designed burner, Fig. 3, burning rate being regulated by a recording pH controller. The corrosion inhibitor also serves as an algaecide and bacteriacide. Use of these two treating chemicals alleviates the most important cooling-water problems met in the plants of this company.

Total treatment cost is 2.1¢ per 1000 gal in gasoline plants, 2.19¢ in compressor stations, when this method is used. *ASME paper No. 54-OGP-3.*



3 Schematic drawing of automatic sulfur burner used for treatment of water circulated through industrial cooling towers, thereby easing sulfur problem

A summary report of projects dealing with the deterioration of cooling-tower lumber. *By Donald R Baker, The Marley Company.*

Deterioration of cooling-tower lumber may be caused by chemical attack or decay. A number of research projects have been undertaken to determine the effect on the wood of various chemicals commonly present in the circulating water. This paper summarizes and compares the results of these projects.

Research projects indicate that sodium carbonate or bicarbonate are about the only chemicals commonly present that cause serious chemical attack. Indications are that much of the deterioration attributed to chemical attack is actually due to decay organisms. Decay may be prevented by preservatives applied before or after a tower is erected. Wood preservatives appear to offer the possibility of preventing most of the deterioration in cooling-tower lumber, if so-called chemical attack is actually caused by decay organisms. *ASME paper No. 54-OGP-4.*

Power distribution

Design and operation of system-wide automatic load-frequency control. *By H A Bauman, C N Metcalf and J G Noest, Consolidated Edison Co of N.Y., and J B Carolus, Leeds & Northrup Co.*

The present-day regulating burden on a 3-million-kw electric system requires that all major generating stations participate automatically in system load changes.

This paper describes automatic computer equipment which compares station loads with preset loading schedules. By means of controlling impulses it functions to satisfy short-time load swings on a basis of available capabilities and sustained load changes to comply with economy loading requirements. The equipment is designed to simplify the load-control functions of the system operator by improved flexibility to meet varying system load and generating conditions.

Experience with this equipment has been very satisfactory, all objectives being fully achieved. Excessive rate of load variations on individual stations has been reduced. Stack appearance is improved.

Adjustments, for setting up a program for load pickup or drop-off in accordance with incremental loading schedules, are convenient to make and require little attention. Load-control functions of the system operator have been simplified. There has been a significant reduction in telephoned orders. *AIEE paper No. 54-257.*

Problems relating to interconnecting of large pulp and paper mills with large utility power systems. *By H A Rose, Westinghouse Electric Corp, and H E Springer, Rayonier, Inc.*

Requirements for electric power in modern pulp and paper mills are increasing at greater rates than the need for thermal power. As a result, electric power that can be generated by the normal flow of process steam is becoming inadequate. Low-cost hogged fuel and mill waste are also no longer available in abundant quantities to generate the increasing unbalance in electrical load with condensing steam.

Mill operators are, therefore, finding it more economical to purchase a portion of their electric energy from utility power systems rather than to operate their own generating equipment on more expensive fuels and with consequent heat loss to the condensing water.

(*Continued on page* 230)

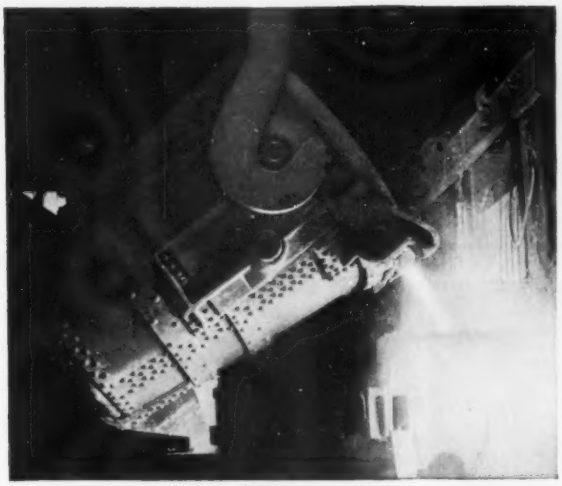
TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from sources, not POWER.

American Power Conference, annual meeting, Sherman Hotel, Chicago, Ill., Mar. 24-26, 1954. Identified by initials APC. Obtainable in proceedings that may be purchased from R A Budenholzer, chairman, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Ill.

American Society of Mechanical Engineers, Oil and Gas Power division, June 14-17, Kansas City, Mo. and International meeting, Mexico City. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, N. Y.



STEEL OUTPUT INCREASED BY 110 TONS PER DAY REPORTS STEEL PRODUCER: Tap-to-tap time reduced from 18 to 12 hours . . . Fuel cut 46% per ton produced . . . Tonnage up 50% daily! That's the job Cities Service Heat Prover helped perform for one of the largest steel producers.

"COMPLETED 30 HOUR TEST IN JUST 6 HOURS!" "We completed what normally would have been a 30 hour test in just 6 hours," writes the Eclipse Fuel Engineering Co. of Rockford, Ill. "We found the Heat Prover equally exact, perhaps more exact than standard commercial testing equipment."

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- **Easy portability**
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Learn how the Heat Prover, supplied and maintained free by Cities Service, can benefit you. For details, contact your nearest Cities Service office or write: Cities Service Oil Company, Sixty Wall Tower, New York City 5, N. Y.

See The Heat Prover in action at the Cities Service Exhibit at the Iron and Steel Exposition, Cleveland Auditorium, Sept. 28-Oct. 1. Booths 483 and 484.

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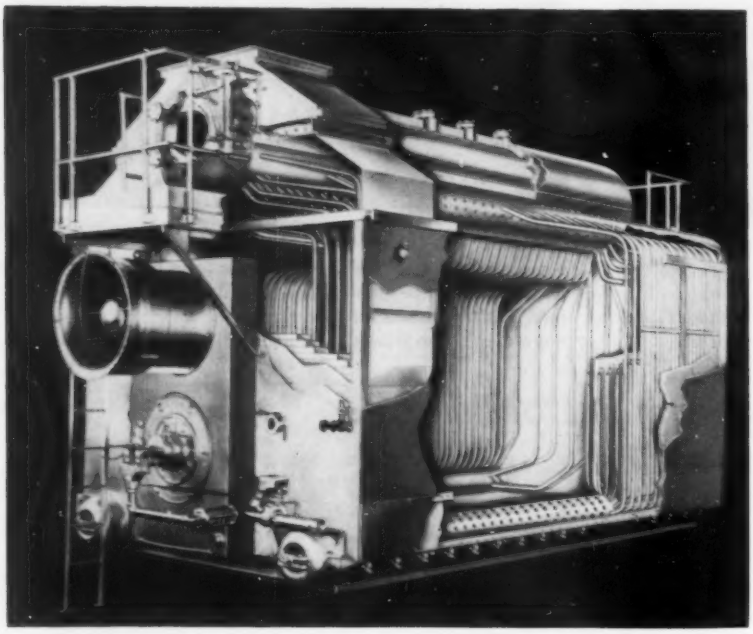
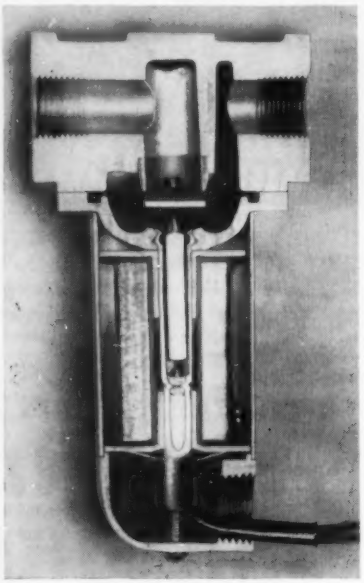


Versatile packaged boiler meets diverse needs

824 • A packaged water-tube steam generator can be fitted with components to meet a broad range of individualized needs for power, process or space heating. Sizes of these standard units range from 10,000 to 40,000 lb per hr and up to 250 psi.

Superheaters of pendant or drainable type, with or without control, can be added to meet total temperature requirements. Furnished for pressurized oil or gas firing, or both, with fully automatic, semi-automatic or manual combustion controls. the unit is also adaptable to stoker conversion. Bulletin MH 3-54.

Union Iron Works, 1420 Cascade St, Erie, Pa.

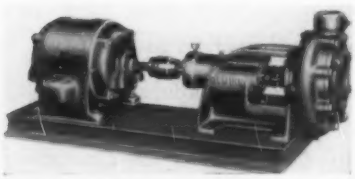


Diaphragm operated solenoid valve

838 • These valves designed for standby control of flow, for automatic cycling of compressors, pumps, boilers and motor-generator sets are available in six pipe sizes from ⅜ to 1½ in. They operate at pressures to 150 psi. Valve can be serviced without removal from line. Request data on *DO* solenoid valves.

Eclipse Fuel Engineering Co, 1011 Buchanan St, Rockford, Ill.

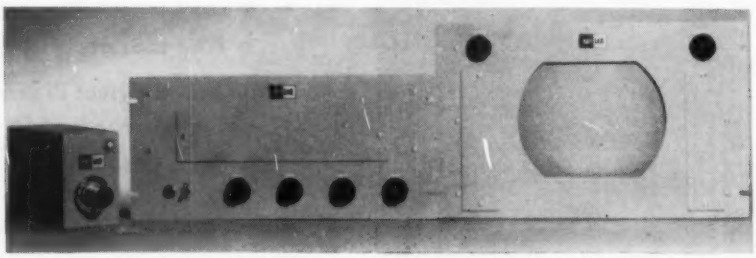
For more data on these items, use post cards p 163. Identify your request with item number



End-suction centrifugal pump

820 • Furnished in capacities to 1000 gpm and heads to 250 feet, this end-suction pump has an axial shaft adjustment that can be made while pump is running and permits regulation of capacity and head, and adjustment for impeller wear. Impeller is semi-open, non-clogging type. For handling liquids with lime chips or other solids an impeller with wiping vanes can be supplied. Bulletin 4011.

The Deming Co, Salem, Ohio

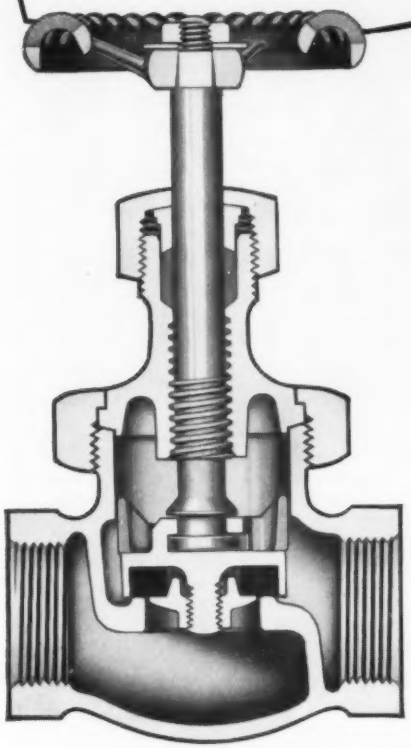


Closed-circuit TV for industry

828 • The *Kay-Lab* television camera system has three basic units: camera, camera control and monitor picture tube. The camera fits in the palm of the hand, costs 15 to 20¢ an hour to operate. Price includes camera, control, monitor cable and lens.

Kalbfell Laboratories Inc, 1090 Morena Blvd, San Diego 10, Calif.

A New Disc . . .
A "New" Valve



Crane No. 7 Brass Valves with quick-change composition disc

Save time, trouble, and money by standardizing on these Crane quality 150-Pound Valves. Simple to service. No big inventory of replacement parts. Just a few extra disc holders . . . a supply of composition discs. That's all you need for a wide variety of fluids . . . and an economical maintenance program.

The composition disc takes most of the normal wear—stands up well under ordinary usage—seats easily even on air and gas—absorbs foreign particles that might cause leakage in metal disc valves. When a leak shows up, make a "new" valve—with a new disc. Simply dismantle the union ring, lift out the trimmings, replace the disc holder assembly. Takes only a few minutes. Save the disc holder you removed—use it with the next replacement disc.

Rugged construction throughout. Sturdy bonnet joint, well reinforced by heavy union ring—can be repeatedly dismantled and reassembled. Get better acquainted with the Crane No. 7 line . . . for steam, hot and cold water, air, oil, gas, gasoline, and many other fluids.

GLOBES, ANGLES, AND CHECKS

Ask for folder AD-1682R—contains full facts on the No. 7 brass valve line and the companion No. 27 check. Your Crane Representative has a copy for you—or write direct to address below.

No. 7 Globe
Sizes ⅛ to 3-inch

No. 7 Angle
Sizes ⅛ to 3-inch

Specify No. 9 for Flanged Ends

No. 27 Check
Sizes ¼ to 3-inch

THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

Begins on page 154

Improved heating pump features 33-1/3% power savings

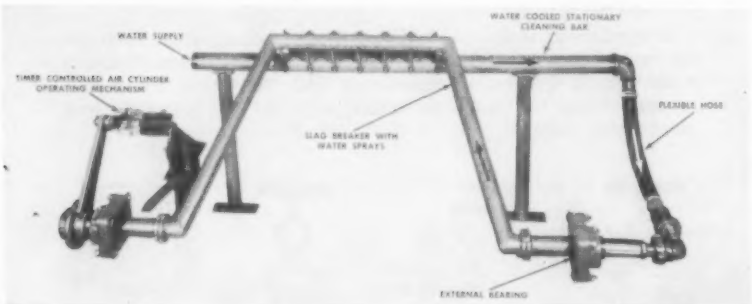
816 • A new model vacuum heating pump is now available utilizing a sliding vane air vacuum pump to displace air entirely separate from the motor driven centrifugal pump that handles condensate returns only.

Advantages claimed for this unit include approximately 33-1/3% savings in electrical consumption, greater air volume displaced, simplified construction and practically no more maintenance than would be necessary for a single condensate return unit only. May run dry without damage.

It is fully automatic and not affected by high-temperature returns. All receivers are cast iron with accessible built-in brass strainers. Accessories like float switches, vacuum switches and gages are conveniently mounted on the receiver.

This *VA* vacuum heating pump is supplied with a single air vacuum pump and water pump, two air pumps, or if desired, two air and two water pumps.

American Hydrovac, 290 Scholes St, Brooklyn 6, N. Y.



Automatic slag breaker for wet-bottom furnace

833 • In the pulverized-coal wet-bottom furnace with continuous discharge of molten ash, stalactites form and hang from the furnace-bottom outlet. The automatic slag breaker breaks and knocks down this slag formation, avoiding the possibility of plugging the discharge outlet from the furnace.

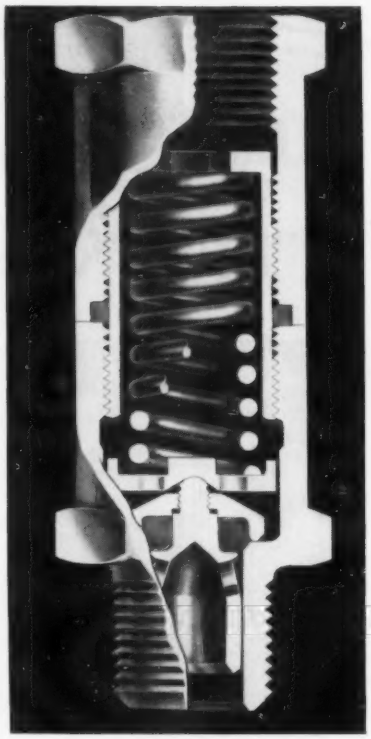
United Conveyor Corp, 37 W Van Buren St, Chicago 5, Ill.

For more data on these items, use post cards p 163. Identify your request with item number.

Steam reducing valve

868 • New pilot-operated steam-reducing valve meets needs of most installations and provides easy pressure adjustments. Pilot uses upstream pressure to open main valve if downstream pressure is too low; if too high, it bleeds off pressure and allows main valve to close as required. Valve is available in sizes from ¾ to 6 in. Complete literature available on request to manufacturer.

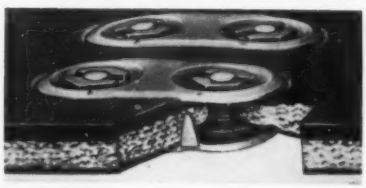
Klipfel Valves, Inc, Hamilton, Ohio



Relief valve

836 • A relief valve using an O-ring seal, and a spring centering device that allows only axial force to be transmitted to the poppet has been announced. The valve shows no leakage with as little as 2% of the pre-set cracking pressure, and reseats with no leakage within as close as 5% of the setting. It is designed for gas and liquid service. It is available in either steel or brass for pressures from 50 to 1000 psi. Also supplied in stainless steel with teflon seal suitable for difficult services.

Circle Seal Precision Valves, James-Pond-Clark, 2181 E Foothill Blvd, Pasadena 8, Calif.



Conveyor belt fastener

869 • Belt fastener for joining conveyor belts in foundries or wherever scrapers and plows are used. Top plates are beveled at both ends to permit scrapers to ride over them. Available in steel, monel and everdur for belts 5/16-in. to ½-in. in thickness with not more than 500 ft centers. Bulletin F-108.

Flexible Steel Lacing Co, 4607 Lexington St, Chicago 44, Ill.

ANKOPRENE BONDED SHEET and CUT GASKETS

Style 450 Sheet; Style 550 Cut Gaskets

widely used for their RESISTANCE TO OIL!

This compressed asbestos sheet packing of The Anchor Packing Company, homogenous in construction, contains an oil-resisting compound. It is approved by the Underwriters' Laboratories.

Ankoprene sheet is used in services involving petroleum oils and distillates, as well as gasoline and all petroleum derived solvents. Ankoprene gaskets are ideal on refrigerating compressors handling Freon or other refrigerants.

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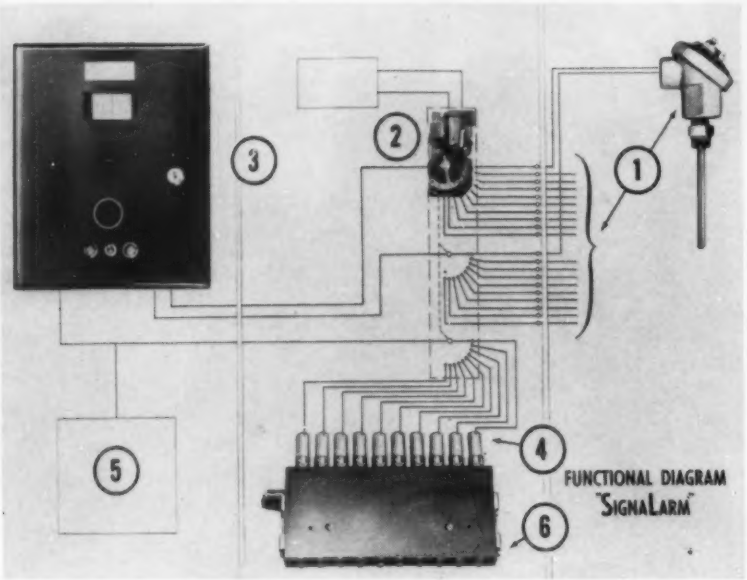
More EQUIPMENT NEWS

Begins on page 154



Light indicator temperature monitoring system

822 • By means of red and green lamps and an audible alarm, *Signalarm* indicates temperature condition at various points as they are scanned. The master measuring unit can be pre-set to give warning signals at a high or low point. Each unit can handle up to several hundred thermocouples or resistance bulbs. Additional systems can be installed for greater capacity or for high-speed scanning. Picture shows: (1) thermocouples (2) impulse timer and stepping switch (3) master measuring unit (4) memory relay (5) audible alarm (6) signal lamps. Ask for bulletin 70.

Thermo Electric Co, Inc, Saddle River Twp, Rochelle Park Post Office, N.J.

Time-saving cable clamp

803 • The *J Clip* is a single shank steel clamp or staple that holds a wide variety of tube or wire snugly where the clip can be driven into wood. Since only one point enters the wood, there is no spreading effect when the clip is driven home, as might occur with a U-shaped staple.

Four sizes are now available: one for ¼-in. through 5/6-in. outside diameters; another for ⅜ through ½-in., and a separate size each for ⅝ and 1-in. Where armored cable is to be clamped, *J Clips* are supplied with gripping grooves on the inner surface to prevent cable slippage. A choice of 5 plated finishes is offered: zinc, nickel, cadmium, copper and lustron.

Barton Staple Co, East Hampton, Conn.

Silicone protected induction motors for outdoor drives

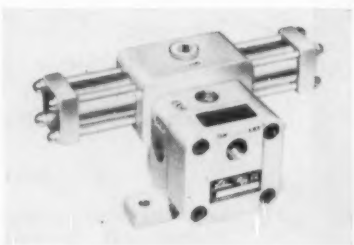
809 • Full protection against moisture and corrosion is provided in this line of weather-protected squirrel-cage induction motors. Called *Sil-Clad*, the motors feature complete silicone insulation on motor winding, silicone enamel baked on all exposed metal parts of the motor and stainless steel on parts subject to air abrasion. Silicone has excellent heat resistance, repels water, is inert to corrosion from most air-borne chemical fumes, resists oxidation and sunlight and is a good electrical insulator.

Full silicone treatment of the motor is designed to provide protection in damp, moist or steamy conditions, in sea coast locations subject to salt corrosion, in chemically active atmospheres or in other situations which induce deterioration by rusting, corroding or moisture penetration.

Mechanical construction of the motor is such, airborne entrance of dirt and particles is minimized. *Sil-Clad* motors are offered in ratings of 250 hp and larger. Ask for bulletin 209.

Electric Machinery Mfg Co, Minneapolis 13, Minn.

For more data on these items, use post cards p 163. Identify your request with item number.



Power operated valves

870 • Disk-type power operated valves are designed for actuating remotely located or automatically operated cylinders. Following features are claimed by manufacturer: "free-floating" piston movement; floating piston bar; use of pilot valves; power return to all positions; non-corrosive materials; complete accessibility for ease of inspection. Available in sizes from ⅜ to 1¼-in. standard pipe connections. Bulletin 1010.

Ledeen Manufacturing Co, 1600 S San Pedro St, Los Angeles 15, Calif.

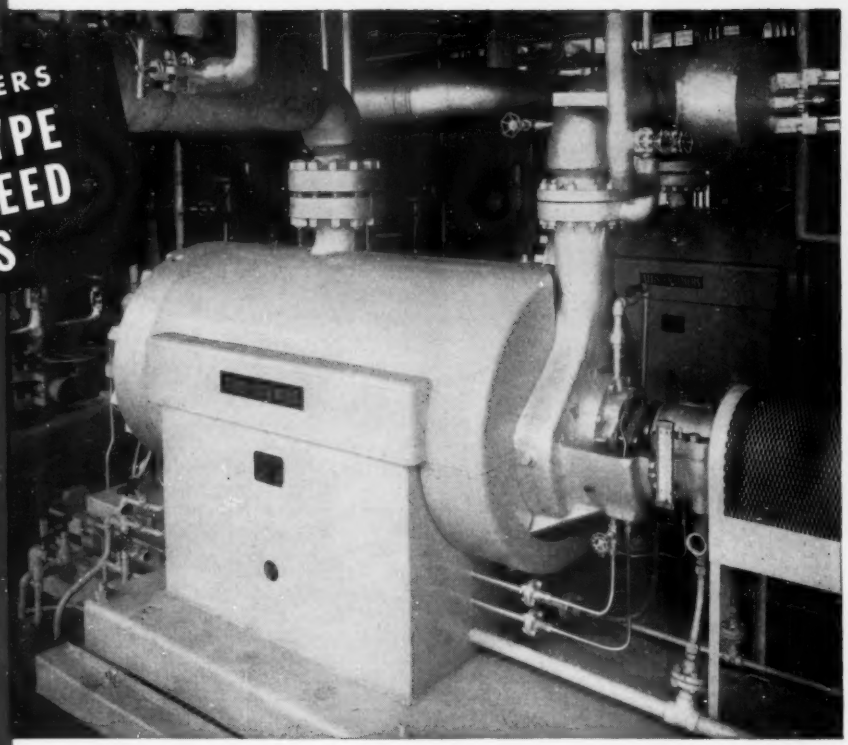
High-temperature switch

823 • A precision switch for switching substantial electrical loads in a temperature range of –50 to 1000 F is offered. At 1000 F the switch has surpassed 9000 operations carrying a resistive load of 2 amps, 28 v, dc. It is designed for panel mounting. Request additional data on *1HT1* switch.

Micro-switch Div, Minneapolis-Honeywell Regulator Co, Freeport, Ill.

ALLIS-CHALMERS

BARREL-TYPE BOILER FEED PUMPS



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LOUISIANA POWER & LIGHT COMPANY
because

PERFORMANCE IS PROVED *in service*

PERFORMANCE RECORDS in power plants all over the country show *low maintenance, high efficiency*... that's one reason Allis-Chalmers boiler feed pumps were chosen for the Nine Mile Point Station of Louisiana Power & Light Company.

PROVED DESIGN FEATURES

Behind the A-C boiler feed pump stand many proved design features. For example: First stage has twin, single suction impellers to give low NPSH requirements for highest efficiency under fluctuating loads. Impellers mounted back to back balance axial forces without the need for a balancing drum. Expansion joint and seals are brought to the outside of the pump . . . they may be inspected often and worked on easily, if required.

COMPLETE UNIT FROM THE SOURCE

Allis-Chalmers can supply the complete pumping unit — pump, motor and control — all of coordinated design and manufacture. You get one responsibility — one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wis., and ask for Bulletin 08B7899.

A-4328

ALLIS-CHALMERS

More EQUIPMENT NEWS

Begins on page 154

High-frequency converter

849 • Five-kw static frequency converter provides 360-cycle square-wave current at 600 v for high-frequency operation of fluorescent lamps. Designed particularly for experimental and commercial plant growth rooms, television and radio studios, luminous ceilings and libraries. Lighting fixtures are lighter and smaller since they do not require conventional transformer-type ballast.

Packaged unit combines functions of frequency converter, step-up transformer, current regulator and square-current generator. It was developed to start and operate 50 lamps with a 0.33 microfarad capacitor in series with each lamp. With this combination, lamp current can be regulated by a single knob in the range of 300 to 500 ma. Number of lamps operated depends on desired maximum lamp current and range of light control required. Unit remains stable with up to 10% lamp failures, although current will increase in remaining lamps.

General Electric Co, Schenectady 5, N. Y.

Leak detector

817 • A chemical detector, *Leak-tec*, spots minute leaks of gases, chemicals, oils, air and other substances. It is non-inflammable, non-explosive and non-injurious to the person using it. In addition to testing for piping leaks, this detector will show up leaks on gas-filled electric cables, transformers and electric generators.

American Gas & Chemicals Inc, 45 Rockefeller Plaza, New York

For more data on these items, use post cards p 163. Identify your request with item number.

Cylinder, positioner unit

871 • Combining cylinder efficiency with positioning accuracy, this cylinder-positioner will operate dampers, coal gates, variable speed drives and other combustion control devices requiring up to six in. stroke with no multiplying linkages needed.

Operating from a 3-15 psi pneumatic controller output, the positioner is a force-balance type of device that applies an air-pressure differential across the cylinder piston. Sensitive and accurate, it responds to a change in signal pressure of ¼ of 1% of range and positions a piston within 1% of its total stroke under normal loading conditions. Technical report TI 31-H-123b, will be sent on request.

The Foxboro Co, Foxboro, Mass.

Rust preventive

872 • Neither a paint, oil, nor grease, *Rust Shield* prevents and stops rust chemically. On contact, it instantly becomes part of the surface. It's claimed that even closest tolerances of precision tools are not disturbed as no trace of film thickness is left. Protection lasts until surface is worn or scratched. If surface is not subject to wear, protection lasts indefinitely.

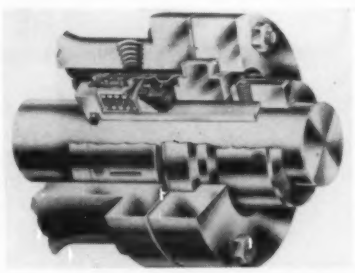
Use as a spray, brush or dip.

Wilbur & Williams Co, 130 Lincoln St, Boston 35, Mass.

Mechanical shaft seal

840 • This mechanical shaft seal is mounted on a sleeve with an outside clamping ring. Arrangement permits quick installation or removal in practically all split-case pumps. The seal can be used to handle corrosive liquids at temperatures to 500 F. Flexible sealing members are made of teflon. Springs and metal parts can be furnished to customer's specifications.

Crane Packing Co, Dept PRN, Chicago 13, Ill.



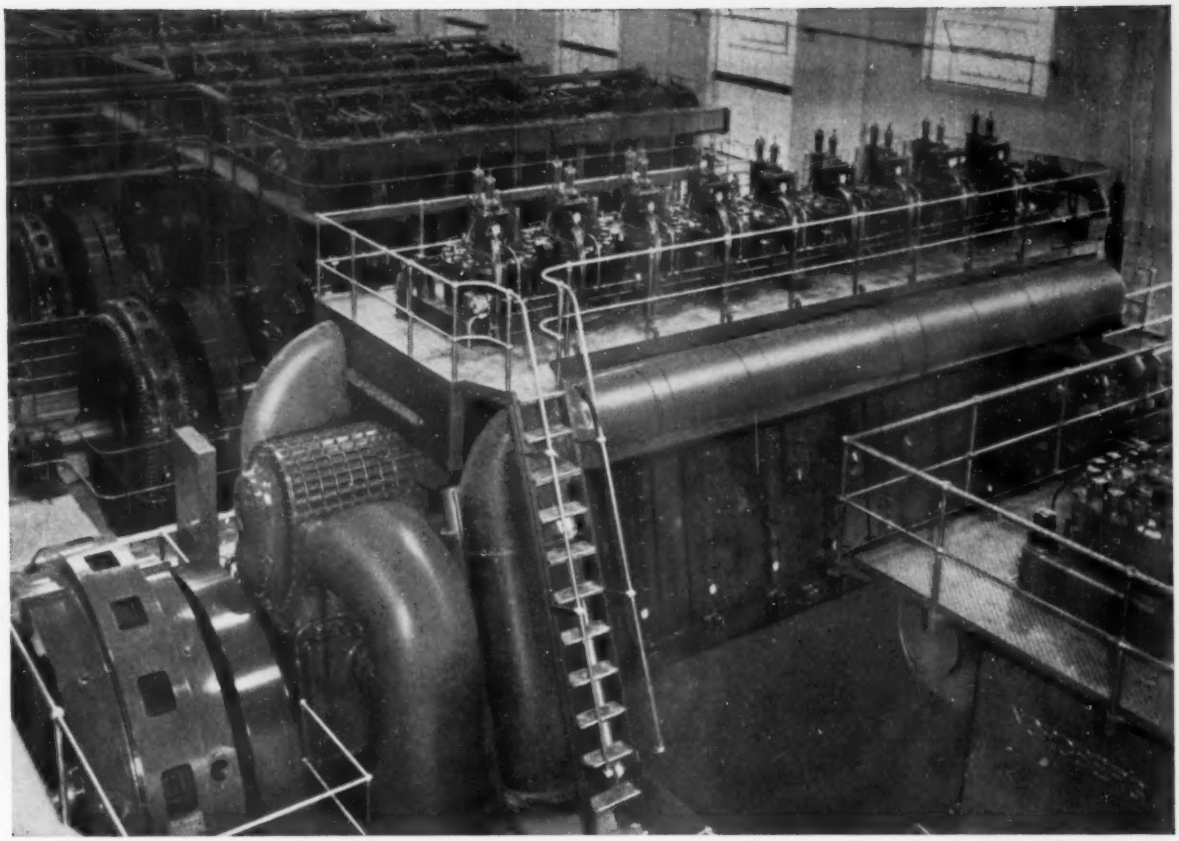
CHECK THESE TOO . . .

Pressure Switch	p 168
Circuit Tracer	p 168
Thermo-cooled Ignitron	p 170
Gas Alarm	p 170
Pneumatic Transmitter	p 172
Lumber Measuring Tape	p 172

Automatic flow switch

844 • Designed to protect machinery, the automatic interlock is operated by means of a differential pressure across the orifice. The unit protects equipment requiring a definite flow of fluid to assure proper operation and prevent damage. Pipe connections are ½ in. for flow of 0.1 to 8.0 gpm, and 1¼ in. for 8 to 40 gpm. Request data on *Shur-flo* automatic interlock.

Industrial Sales Div, Hays Mfg Co, 812 W 12th St, Erie, Pa.



Largest Diesel Power Generating Station in the U.S.

reduces cylinder and piston ring wear with SHELL ROTELLA OIL

Electric power for the City of Grand Haven, Michigan, and the surrounding area, is generated by diesel engines in the largest municipal power station of its kind in the U. S. A. Shell Rotella Oil is the cylinder lubricant.

The anti-corrosive action in Shell Rotella Oil combats the major cause of engine wear . . . cylinder and piston ring wear caused by acid action from the by-products of incomplete combustion and condensation.

Tougher lubricating film in Shell Rotella Oil gives cylinders and rings greater protection . . . minimizes wear. Its effective detergent-dispersant action prevents harmful deposits.

Write for technical information. See for yourself how Shell Rotella Oil can help reduce your engine maintenance costs.

SHELL OIL COMPANY
50 WEST 50TH STREET, NEW YORK 20, NEW YORK
100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL

Mead-Morrison

means **modern** *material handling*

When you buy a Mead-Morrison Tower, you can be sure of MODERN design to meet today's demands for effective design and efficient operation. Note these Mead-Morrison characteristics:

Sturdy Construction . . . demonstrated by the many installations that are giving trouble-free service year after year,

Speedy Unloading . . . exceeding the specified hourly rate in many cases,

Simple Operation . . . all grab movements controlled by only 2 conveniently arranged latched levers,

Smooth Control . . . new standards of ease and smoothness in both free digging and clean-up,

Specially Engineered for Each Installation . . . by a long experienced organization backed by complete manufacturing experience.

Mead-Morrison engineers will be glad to help you plan your new unloading facilities or give advice on increasing the capacity of your present equipment.

Mead-Morrison Rope Trolley Stationary Coal Barge Unloading Tower recently installed at the Meramec, St. Louis, Plant of the Union Electric Company of Missouri. The tower has a capacity of 600 tons per hour (throughout a barge), and is equipped with a 7-ton Mead-Morrison Grab Bucket. The plant also has a Mead-Morrison Barge Haul System which works in conjunction with the tower.

MEAD-MORRISON

Division of McKIERNAN-TERRY CORPORATION

Builders of Coal and Ore Towers and Bridges, Grab Buckets, Pile Hammers, and Special Machinery

HARRISON, NEW JERSEY

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330 West 42nd Street
New York 36, N. Y.

AIR CONDITIONING, HEATING

1 **Commercial air conditioning** cooling tower catalog WT & CT-583 has 16 pages. Includes photos, specs, selection and installation information. Halstead & Mitchell, Bessemer Bldg, Pittsburgh, Pa.

2 **Dust and fume control** systems are described in 4-page bulletin. Flow granule principle is detailed. Mechanical Industries, Inc, 950 Grogan Bldg, Pittsburgh 22, Pa.

3 **Use of multi-louvre dryers** for pelletizing and drying coal is described in 8-page bulletin No. 2507. Reprint of paper presented at AIME and ASME fuel conference. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

BOILERS AND AUXILIARIES

4 **Packaged steam generators,** type MH, described in 14-page bulletin. Photos, specs and a description of production of the units included. Union Iron Works, Erie, Pa.

5 **Condensate and air separator** is detailed in 4-page illustrated folder. Has pressure range to 350 psi. MacKenzie Steam King, 213 E 55th St, New York 22, N. Y.

6 **Water gages** and columns for boiler pressures 400 to 2500 psi are described in 20-page catalog WG-1814. Includes description of 12 major improvements in this type gage. Yarnall-Waring, Mermaid Lane, Philadelphia 18, Pa.

7 **Heavy-oil burners,** belt driven rotary type. From 7½ to 175 gph capacity. Explained and illustrated in 8-page bulletin 175-H. Three models designed for No. 5, 5 and 6 fuel oils respectively. Includes charts and specs. Preferred Utilities Manufacturing Corporation, 1860 Broadway, New York 23, N.Y.

8 **Proportional mixers** for air and gas is the subject of 4-page bulletin L. Includes photos of mixers, diluters and injectors and charts. Eclipse Fuel Engineering Co, 1001 Buchanan St, Rockford, Ill.

COMPRESSORS

9 **Heavy-duty air compressors** described in 36-page bulletin A-72. Seven models are illustrated, from 1186 to 1948 cfm. Includes twin units that deliver up to 3896 cfm. Joy Manufacturing Co, Oliver Bldg, Pittsburgh, Pa.

10 **Rotary compressors,** single stage water-cooled type and vacuum pumps are shown in 12-page bulletin 16B8126. Includes general specs and typical piping arrangements. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

11 **Miniature air compressors.** High-pressure, light-weight type are discussed in 4-page product sheet No. 5. Includes data on design and performance features. The Cornelius Co, 550 39th Ave NE, Minneapolis 21, Minn.

CONTROLS

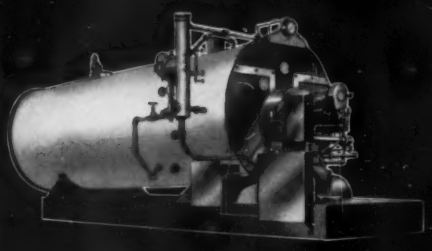
12 **Circuit breakers,** disconnect switches and other component parts are listed in 100-page catalog GEC-1025. Includes all parts used in switchboards and panelboards. General Electric Co, Trumbull Components Div, Plainville, Conn.

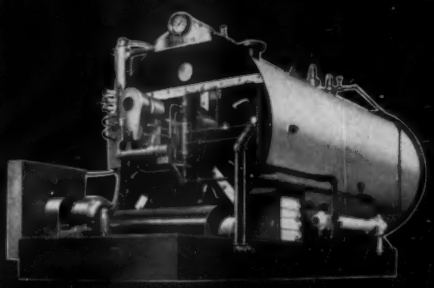
13 **Process timer.** 8-page bulletin GEC-1223 describes the operation, advantages and applications of new process timer. Includes diagrams, photos, prices and specs. General Electric Co, Schenectady, N. Y.

14 **Automatic combustion control** for oil, gas or coal-fired boilers is illustrated in 4-page bulletin C-101. Includes photos, dimensions, charts and specs. Reliance Instrument Mfg Corp, 190 Glen Cove Ave, Glen Cove, L. I., N. Y.

15 **Two-lever coordination control** is discussed in 8-page bulletin No. 68123. Includes photos, drawings, capacities, mounting details. Pantex Mfg Corp, PO Box 660, Pawtucket, R. I.

(*Continued on page 226*)





Behind these clean lines

a PROMISE of PERFORMANCE

Look at a Superior Steam Generator. Compare it with any other on the market. In the clean lines of its integrated design you'll see the promise of performance. Then talk to your Superior Sales Engineer. He has the facts and figures to show how Superior has fulfilled this promise.

Write today for Catalog 600 and the name of your nearest Superior Sales Engineer.

BANK

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

George Edwards' Scrapbook

Steel produced for each person in the U.S. in 1953 was 1398 pounds. In 1940 it was 1015, in 1920 only 886. Just think of all the power tools needed to machine that metal into the various items we use every day. Then think of the power needed to operate that metal once it's made into powered lawn mowers, refrigerators, etc. You can't help but feel that we power engineers are growing more important as time goes on.

' ' '

When you get what you want
In your struggle for self—
And the world makes you King for a day,
Just go to a mirror and look at yourself;
And see what that man has to say.
For it isn't your father or mother or wife
Who judgment upon you must pass.
The fellow whose verdict counts most in your life
Is the one staring back from the glass.
Some people may think you a straight-shootin' chum
And call you a wonderful guy;
But the man in the glass says you're only a bum,
If you can't look him straight in the eye.
He's the fellow to please,
Never mind all the rest.
For he's with you clear up to the end,
When you've passed your most dangerous,
difficult test.
If the man in the glass is your friend,
You may fool the whole world
Down the pathway of years,
And get pats on the back as you pass.
But your final reward will be heartaches and tears
If you've cheated the man in the glass.

—Author unknown

A college education never hurt anyone willing to learn something afterward. —G F KERNAN

' ' '

Just heard of a Detroit automobile plant that solved the problem of employes piling trash on the outside of a trash barrel. Each barrel has a backstop, made of scrap sheet-metal and painted like a target. "Aim Here," says the sign on the bull's-eye. Now the plant workers do just that and all trash goes inside the barrel where it belongs.

This is an old idea, but most of us never learn it: Make a game out of a job and everyone cooperates. Bawl the hell out of people for giving you trouble and you have more trouble than ever. Why not try it?

DID YOU KNOW that electric power sold from early Edison central stations was metered by chemistry? An Edison chemical meter like the one Kenneth Perry of the Smithsonian is showing to a curious student was installed at each customer's place. The jars contained a zinc solution with immersed electrodes through which a fraction of the current passed. Current precipitated zinc in proportion to the power used. The meter "reader" collected the jars and someone weighed each electrode to determine the quantity of current used. The lamp in the box kept the temperature from dropping too low.

My friend, Frank Taylor, of the Smithsonian Institution says that an old operating engineer told him that the term "central station" came from Edison's original plan to divide a city into areas one mile square and to place a generating station at the central point in each area.

Be sure to visit the interesting exhibits in the engineering buildings of the Smithsonian, in Washington, D. C., before too long. You'll find many things of interest that you'll be talking about for a long time.

Take interest, I implore you, in those sacred dwellings which one designates by the expressive term **laboratories.** Demand that they be multiplied, that they be adorned; these are the **temples** of the future—temples of well being and happiness; there it is that humanity grows greater, stronger, better. —LOUIS PASTEUR

' ' '

Here it is again. The Society for the Advancement of Management surveyed 250 top executives in a wide variety of business organizations. They asked what personal assets they considered most important to men who get ahead in management. Don't guess, because it isn't technical knowledge. Seventy percent of them said it was the ability to understand people and to get along with them.

After all, if we can't get along with our fellow man, what good is anything—including science?

George Edwards
Engineer

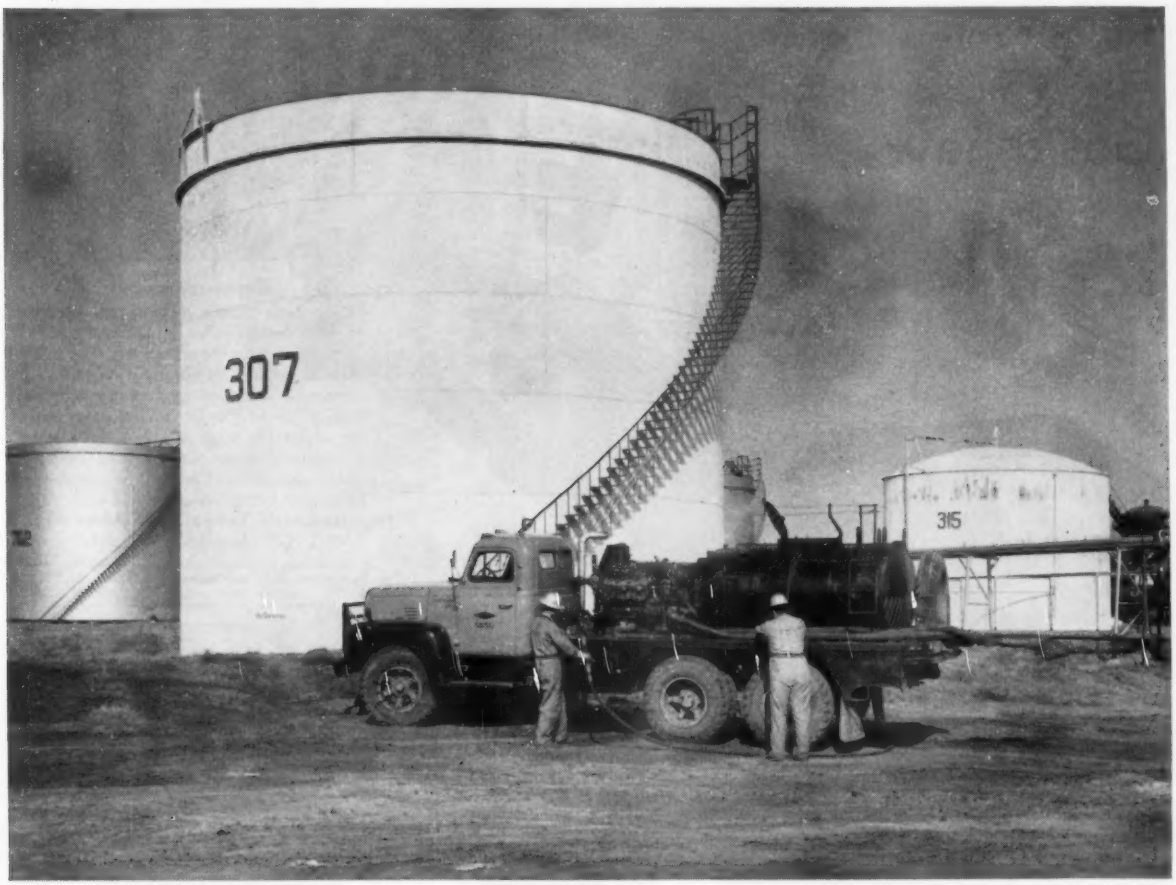
6 TANKS CLEANED IN 5 HOURS

Chemical cleaning by DOWELL prepared 216,000-gallon oil tanks for conversion to sulfuric acid storage

A steel company wanted to convert six 216,000-gallon tanks from fuel oil and gasoline storage to sulfuric acid storage. It was necessary to remove oil and tar film from the inside walls and ceilings of these tanks.

Dowell engineers, using special high-pressure hoses and nozzles, sprayed thickened chemical solvents over all internal surfaces from the tank floor. No scaffolding was required. The thickened solvents clung to the tank walls during the cleaning process. The entire surfaces of all six tanks—including seams, rivets and braces—were cleaned in only five hours.

Whatever *your* cleaning problem—pipe lines, boilers, process equipment, water wells—take it to Dowell. Their engineers have the experience, materials and equipment to help you cut cleaning costs—keep up production. Get in touch with the nearest of over 130 offices or write direct to DOWELL INCORPORATED, Tulsa 1, Oklahoma, Dept. H-23.



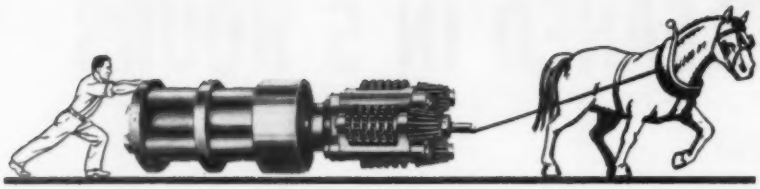
Dowell engineers prepare solvents based on the type of deposit to be removed. They furnish all necessary pumping and control equipment. And they apply the chemicals according to the technique demanded by the job: filling, spraying, jetting, cascading or vaporizing. Dismantling is held to a minimum.

DOWELL SERVICE

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY



Obsolete Tube Cleaners
waste time, labor, and money

Even if you rarely use tube cleaners, you can't afford to be without a powerful new ROTOJET. A ROTOJET should save you enough in time, labor, and air in one cleanout to pay for itself. You won't believe a tube cleaner can pack such tremendous power until you try the new ROTOJET.

Get a new

ROTOJET®

Model S-530 ROTOJET Air-driven Motor with swing-frame head for 3¼ - 3-13/16 I.D. straight tubes.

We can ship promptly complete ROTOJET Tube Cleaners for all tube sizes and shapes. Roto heads, brushes, universal joints, air valves, lubricators, hose, and accessories are stocked ready for shipment.

Wire or phone us if you are in a hurry.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue **Newark 1, N. J.**

More EQUIPMENT NEWS

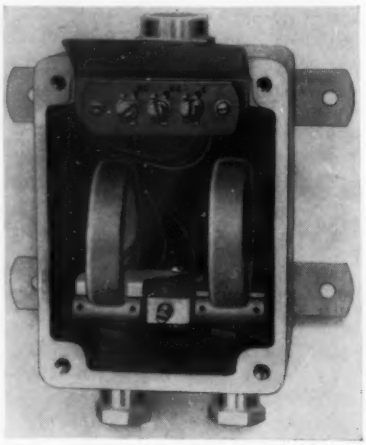
Begins on page 154

Thermocouple extension wire

845 • Type PN wire has polyvinyl-insulated conductors and nylon insulation overall. Smaller diameter permits up to 10% more wires in a given conduit, according to maker. New insulation boasts increased resistance to flame, moisture, petroleum products and fungus.

This polyvinyl-nylon insulation is made for iron constantan, copper constantan and chromel alumel wires in 14, 16, and 20 gage.

Thermo Electric Co, Inc, Saddle River Twp, Rochelle Park PO, N.J.

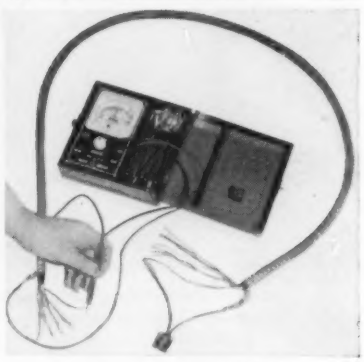


Pressure switch

825 • Unit senses a pressure difference between two variable pressures or a variable and a reference pressure. The switch permits opening or closing a circuit on increasing or decreasing pressure difference from 15 to 10,000 psi at any point within the adjustable range of the model selected. Recommended to operate relays, solenoids, motor controls and other similar devices. Request information on model 532.

Barksdale Valves, 5125 Alcoa Ave, Los Angeles 58, Calif.

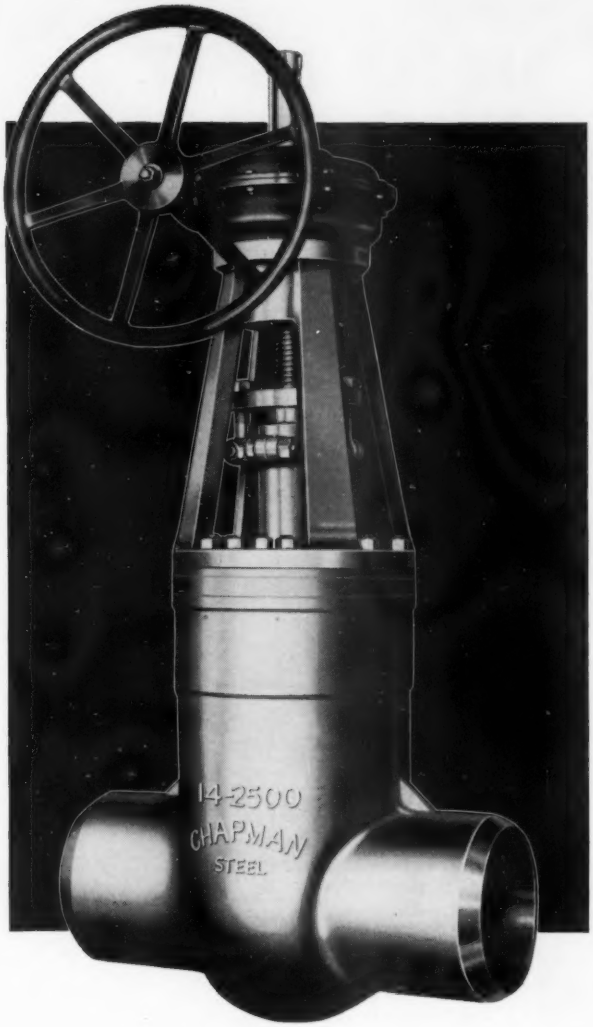
For more data on these items, use post cards p 163. Identify your request with item number.



One-man circuit tracer

846 • One man can trace electrical cable circuits with this meter. Electrician simply slips a tagged jumper on each wire at remote end of line. Then he touches wires at other end of line with probe.

As each circuit is touched, meter indicates



Special Qualities at Standard Prices

...in CHAPMAN Steel Valves

When you buy Chapman Steel Valves, you buy dependable operation and low maintenance cost — you can select steels to meet your specifications from over a dozen alloys made in Chapman's own steel foundry, under rigid scientific supervision.

When your valves are Chapman, you're sure they seat tightly and accurately, without jamming, chattering or wearing excessively. Close tolerances mean long service and little maintenance.

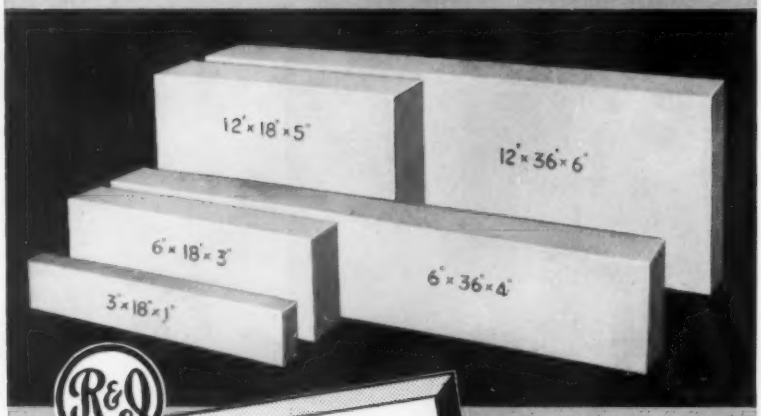
The Chapman Steel Valve line, — gates, globes, and checks, is complete for pressures of 150, 300, 400, 600, 900, 1500 and 2500 pounds and temperatures to 1000°F; all types of gates and globes excepting the 150 lb. class are available with 3 types of bonnet joints — welded, pressure seal, or bolted. Each has its own particular application depending on the medium to be handled.

Chapman's long experience and mass production mean economies. Quality is unsurpassed. So it pays to see Chapman first for every steel valve requirement . . . standard or special, gate, globe, angle or check. Chapman Steel Valves equal or exceed A.S.A. standards in every range. Write now for Catalog No. 20.

The CHAPMAN Valve Manufacturing Co.

INDIAN ORCHARD, MASSACHUSETTS

The Ideal SINGLE LAYER INSULATION



R&I

INSULATING BLOCK

for High or Low Temperatures

R & I #14 Block applied to refractory tile of boiler wall.

R & I Insulating Block is one of the strongest and most efficient rigid insulating materials for boiler refractory walls, breechings, ducts, heaters, storage tanks, turbines, etc.

Light—resilient—resistant to steam and water—easy to cut or saw to any shape and install.

Because of its low heat conductivity at high or low temperatures, its single layer construction costs less to apply than combination or two-layer insulating blocks.

There are 3 TYPES

R & I Mineral Wool Block—for temperatures to 1200° F.

R & I #14 Insulating Block—for temperatures to 1400° F.

R & I #18 Insulating Block—for temperatures to 1800° F.

Available in thickness from ½" to 12" and sizes from 3" x 18" to 12" x 36". Prompt delivery.

REFRACTORY & INSULATION CORP.

R&I

REFRACTORY BONDING AND CASTABLE CEMENTS
INSULATING BLOCK, BLANKETS AND CEMENTS

132 WALL STREET • NEW YORK 5, N. Y.

More EQUIPMENT NEWS

Begins on page 154

the correct number as tagged by jumper. Nine wires can be identified. If there are more lines or circuits, they can be identified and marked in groups of nine.

Neon indicator checks if line is live before test is made. Should a wire be grounded, meter needle will not move. Nine tagged jumpers, the probe and meter are contained in a carrying case. Total weight is 3½ lb.

The Jackson Electrical Instrument Co, 18-36 S Patterson Blvd, Dayton 2, Ohio

For more data on these items, use post cards p 163. Identify your request with item number.

Thermostat-cooled ignitron

850 • Provision for thermostatic control of cooling water is supplied on this size B ignitron to reduce cooling water consumption and provide protection to tube and associated equipment if water fails.

This is a sealed, stainless-steel jacketed, water-cooled, mercury-pool tube. It is capable of replacing the standard model directly, with the advantage of provision for suitable thermostatic control. A calibrated thermostat, attached to side of the tube, may be used to stop tube operation in case of insufficient water flow or may be used with a solenoid water valve to turn cooling water on and off as needed.

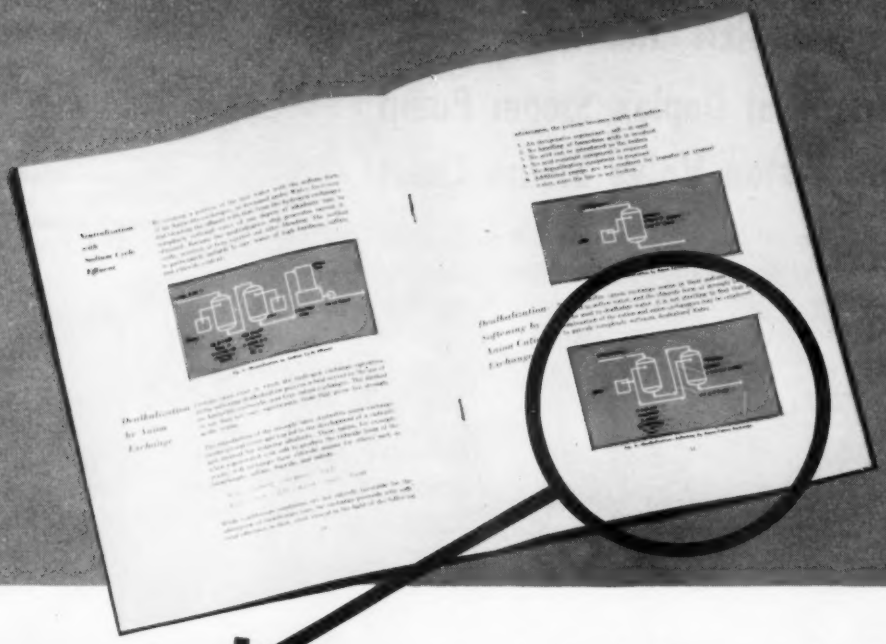
Tube is designed primarily for resistance welding control. Two tubes normally used with single-phase welders will control 600 kva at 250 to 600 v over a 25 to 60 cycle frequency range.

Westinghouse Electronic Tube Div, Dept T-061, Box 284, Elmira, N. Y.

Combustible gas alarm

829 • Self-contained combustible gas alarm offers explosion protection for single-point hazardous operations. These include drying ovens, hydrogen-brazing area, fuel piping, tunnels, engine testing area and

AMBERLITE ION EXCHANGE RESIN REDUCES ALKALINITY WITHOUT ACIDS OR DEGASIFIERS



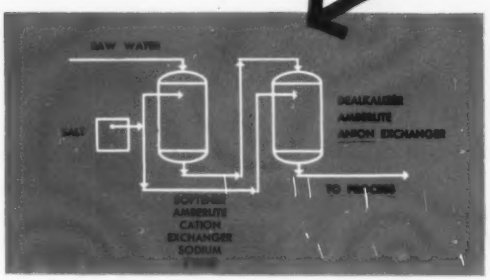


Fig. 6—Dealkalization-Softening by Anion-Cation Exchange

A strongly basic AMBERLITE anion exchange resin permits control of alkalinity of water supplies for boilers and cooling systems conveniently and at low cost. Only common salt is required as regenerant for the resin. No acids are used, hence expensive acid-resistant equipment and associated handling problems are eliminated. Because no degasifier is required, line pressure is not broken, and pumping costs are reduced.

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

AMBERLITE *is a trademark, Reg. U.S. Pat. Off. and in principal foreign countries.*

New Book Gives Valuable Information on Water Treatment Problems

Rohm & Haas Company's new book, *If You Use Water*, discusses this up-to-date technique —and many other ion exchange methods of water treatment as well. Softening, combination softening-dealkalization, silica removal, deionization, are just some of the topics considered. Your request for this book will bring you a copy promptly, will show you why in ion exchange the resin that's *right* is AMBERLITE.

Send for your free copy of this book today

ROHM & HAAS COMPANY
Washington Square, Philadelphia 5, Pa.

Please send me a copy of "If You Use Water..."

Name_____

Title_____

Address_____

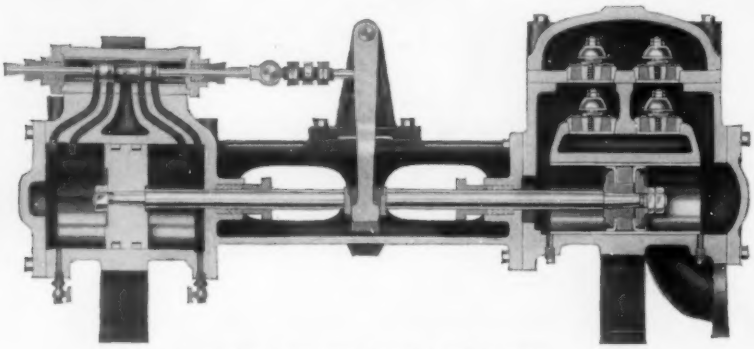
City_____ Zone____ State_____

95% Pumping Cost...

"For FREE"

Via WARREN "Realwear" Horizontal Duplex Steam Pump with Piston Valve Steam Chest

featuring special steam piston ring and steam chest piston valve ring construction, in addition to balanced steam chest piston valves and graphitic iron liners.



NOTE THESE ADVANTAGES:

- Oil-free exhaust steam.
- Clean exhaust steam for any purpose.
- Protection of boilers.
- No contamination of returns.
- Economy . . . 95% recovery of fuel cost when exhaust steam utilized.
- Reliability . . . not dependent upon electricity.
- Flexibility to meet varying load conditions with efficiency at all points.
- Adaptability to either manual or governor control and to long periods of shut-down, if necessary, without addition of oil or graphite.
- Elimination of any type lubricator.
- Outside valve adjustment.

This construction can save you money on Boiler Feed and all Steam Processing applications.

WARREN QUIMBY PUMPS

P-32

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

Warren, Massachusetts

More EQUIPMENT NEWS

Begins on page 154

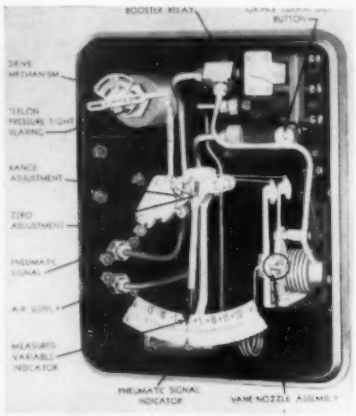
chemical laboratories.

Model *SM* alarm is in a 14 x 5¾ x 19½ in. dust-proof cabinet, and is designed for surface or flush mounting.

Vapor samples are drawn continuously through tubing from the point of potential hazard, and explosibility is shown on an indicating meter in the open face of housing. When combustibles reach a preset level ranging from 0.1 to 1.0 of the lower explosive limit, an internal relay closes the circuit, actuating whatever signal lights or horns user may wish to connect.

Unit requires 50 watts on 115 v 60 cycle single-phase power, weighs 55 lb.

Johnson-Williams, Ltd, 2708 Park Blvd, Palo Alto, Calif.



Pneumatic transmitter

830 • Unit transmits measurements of flow, level, pressure, temperature, differential and vacuum. Transmitted signals of 3-15 and 3-27 psig may actuate pneumatic receivers or controllers. Accuracy is within ½% of the measured range span. Transmission distances can be 1000 ft to receivers and 400 ft to controllers. When writing for literature, specify the measured variable.

Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio

For more data on these items, use post cards p 163. Identify your request with item number.

Rule measures board-feet

815 • Pocket-size lumber rule reads directly in board-feet. Called the *Lumtape*, it is first lumber-measuring device that can be carried in pocket. No arithmetic is needed to convert board-feet because rule reads directly.

Lumtape Corp, PO Box 614, Hillside, N.J.

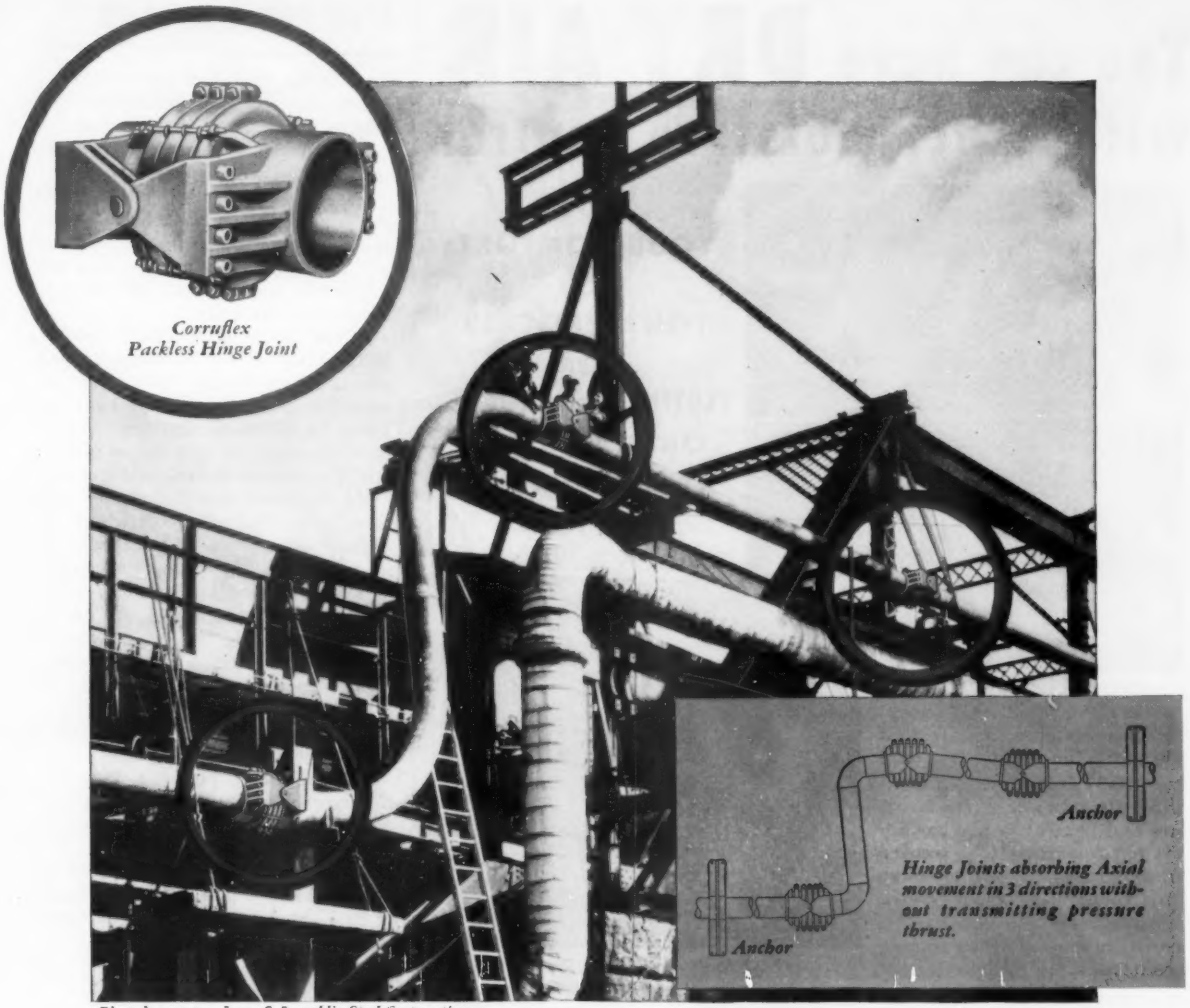


Photo by courtesy Jones & Laughlin Steel Corporation

HINGING A 14" STEAM LINE

● The Jones & Laughlin Steel Corp. in Pittsburgh last year had an excess of steam on one side of the Monongahela River and not enough on the other, where it was vitally needed. To correct this condition, J & L engineers planned to construct a high-pressure, superheated steam line along existing bridges and trestles to transmit the excess of steam to the other side.

However, a great difficulty soon appeared. If conventional expansion joints or loops were used at the 90° turns, pressure thrusts at anchor points would have been great enough to damage the bridges and trestles and actually cause these structures to collapse into the river.

Obviously, something else had to be used. With the aid of Adsco's Engineering Department, J & L "hinged" the pipe line with Corruflex Hinge Joints. These joints cannot develop pressure thrust because their two ends are held apart. They permit movement of a pipe line while keeping anchor loads at a minimum. When used properly, as pictured here, they will permit axial motion of one section of pipe line by permitting angular motion of another section.

Hinge Joints are only one type in the diversified Corruflex line of packless expansion joints. If you have a pipe expansion problem, consult Adsco. Making the world's most complete line of expansion joints, both slip and packless, Adsco will have the right answer.

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ATOM POWER IN 10 YR.

Continued from page 83

discharging used fuel has reached a steady state, fuel in the reactor will have an approximate "exposure", of one-half, so remaining value of fuel in the reactor is half of its initial cost.

During this extended period, while the original fuel is being burned down to half exposure, it is not necessary to add fuel. The resulting operating saving can be used to "pay off" the consumption of inventory.

In addition to the fuel in the reactor, McCune noted that a moderate stock pile is required—say, 10% of one reactor charge. Further financial analysis led to his conclusion that fixed charges of 9.6% should be assessed on 60% of initial investment in one reactor charge.

He predicted that the reactor type most likely to become competitive in the higher-fuel-cost areas of the U.S. in the near future will be one both moderated and cooled by ordinary boiling water. This avoids the high cost of "heavy" water and the big investment required to transfer heat from a primary coolant to steam-generating heat exchangers. In this boiling type of reactor, steam is generated directly in the reactor without an intermediate exchange fluid.

McCune's cost estimates compared this type of reactor plant with a fuel-fired steam plant of the same capacity —300 net megawatts of electricity. It is assumed that both plants operate at base load with a plant utilization factor of 80%. Steam conditions are as shown in the following table.

	Boiling reactor plant	*Coal plant*
Electrical output (net capability), mw	300	300
Plant utilization factor	0.8	0.8
Steam temperature, F	450 (sat)	1000
Pressure, psia	421	1450
Net plant thermal efficiency, %	24	35
Heat generated, mw	1250	857

Comparative total investments are shown below:

	Boiling reactor plant, per kw	*Coal plant, per kw*
Physical plant	$195	$140
Land	2	2
Engineering	15	11
Start-up	14	7
Nuclear-fuel inventory	17	—
Total	$243	$160

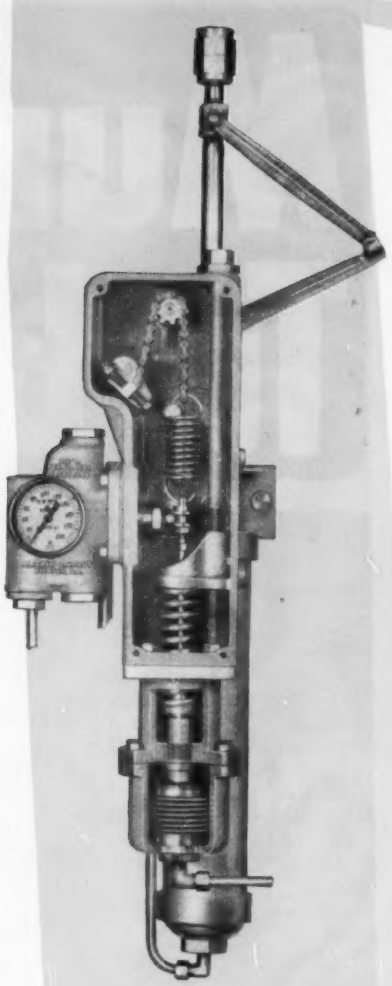
Each item, except land, has been estimated somewhat higher for the atomic plant than for a conventional plant. Also, note allowance for fuel inventory.

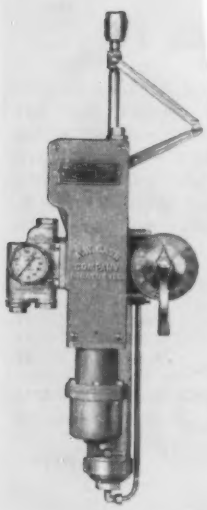
Here are the estimated costs of electricity from these two plants:

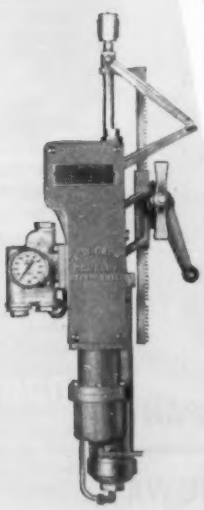
	Boiling reactor plant, per kwhr	*Coal plant, per kwhr*
Fixed charges	4.65 mills	3.0 mills
Operating cost	.70	.5
Fuel	1.35	3.4 *
Total	6.7 mills	6.9 mills

*Coal at 35c per million Btu

(*Continued on page* 176)







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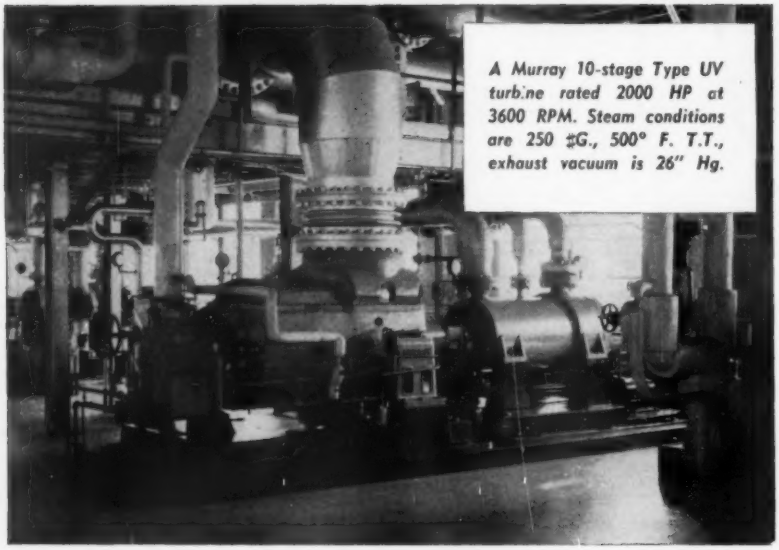
Murray Turbines



A Murray 10-stage Type UV turbine rated 2000 HP at 3600 RPM. Steam conditions are 250 #G., 500° F. T.T., exhaust vacuum is 26" Hg.

● The Murray Type UV turbine pictured above has been driving a high pressure lean oil pump in a Southwestern refinery for the past 10 years. And is still giving dependable, trouble-free service.

Murray mechanical drive turbines both single and multi-stage can be furnished in a wide range of ratings for steam pressures ranging from 0 to 600 #G., condensing and non-condensing. Types in the higher pressures available for up to 250 #G. back pressure.

MURRAY IRON WORKS COMPANY

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ATOM POWER IN 10 YR

Continued from page 174

These figures were computed using the financial assumptions previously outlined. The atomic power appears to be competitive with the coal plant using coal at 35c per million Btu—a price now paid in a number of sections of the country. The fixed charges are higher on the atomic plant. Operating charges, other than fuel, are slightly more. Big difference is in relatively low fuel cost—1.35 mills for the long-burnup fuel.

The studies assume that each ton of fuel can deliver 10,000 megawatt days before discharge from the reactor. This corresponds to a fissioning of 1% of the total atoms in all kinds of uranium.

Since the fissionable U-235 portion of natural uranium is only 0.7%, the study assumes the conversion to plutonium, and subsequent fissioning, of a significant number of U-238 atoms.

The study also assumes that there will be no appreciable rise in the cost of uranium and that moderately enriched uranium will be available from the government gaseous diffusion plants at a "fair price." The proposed plant would make no attempt to reprocess uranium after exposure in the reactor.

Graphite unit equally attractive

McCune said that GE is also enthusiastic about the possibilities of a graphite-moderated watercooled reactor, a direct descendant of the original plutonium-producing reactors at Hanford. The studies are based on a plant of 700 megawatts for one reactor. The following table gives the data on this plant.

Electrical output (net capability), mw	700
Plant utilization factor	0.85
Steam temperature, F	370 (sat)
Steam pressure, psia	180
Coolant outlet, F	540
Coolant inlet, F	390
Net plant thermal efficiency, %	23
Reactor heat rating, mw	3000

The 700-megawatt net-kilowatt electricity for sale is obtained from five 150-megawatt turbine-generators, taking steam at 370 F from 30 heat exchangers. Heat exchangers take water from the reactor at 538 F and return it at 388 F.

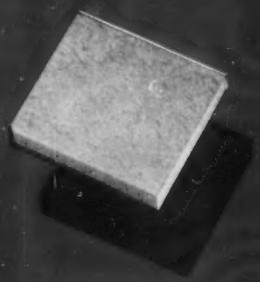
The following table summarizes the estimated investment:

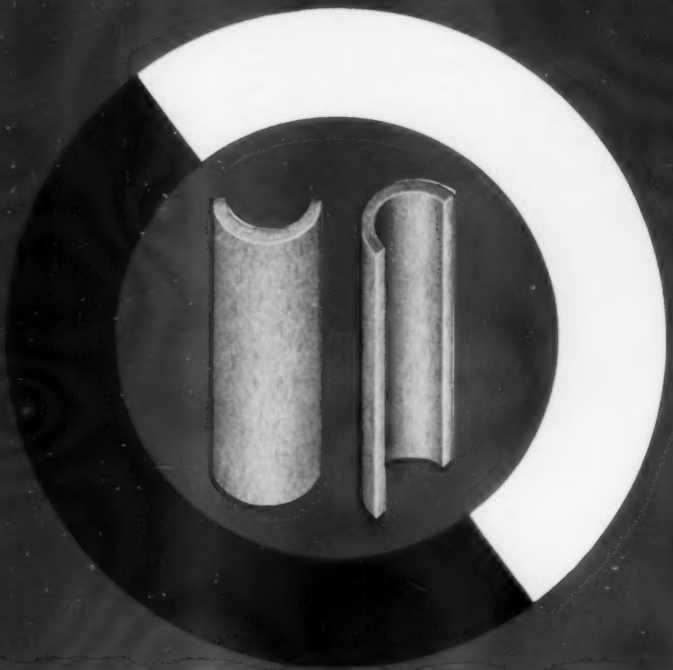
	Investment	*Per kw*
Physical plant	$150,000,000	$214
Land	500,000	1
Engineering	12,000,000	17
Start-up	12,000,000	17
Nuclear-fuel inventory	19,500,000	28
	$194,000,000	$277

Following table shows an estimated power cost of 6.8 mills per kwhr:

Fixed charges	5.2 mills per kwhr
Operating cost	.6
Total Nuclear fuel	1.0
Total	6.8 mills per kwhr

(*Continued on page* 178)





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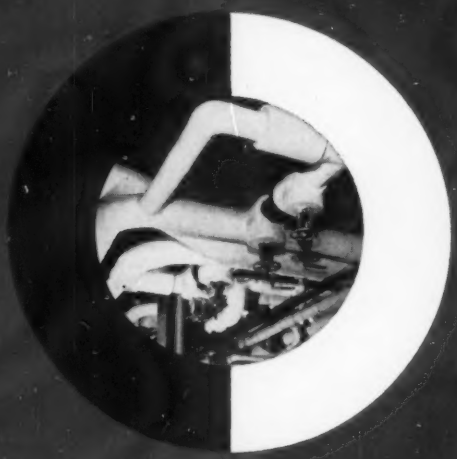

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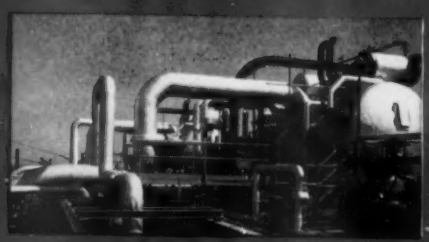

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ATOM POWER IN 10 YR

Continued from page 176

Discussing these estimates, McCune said, "The numbers . . . are arrived at from actual construction experience. We know what it will cost and don't have to guess. The engineering is that which we have developed from many years of technical effort. The basic engineering is essentially done. Why then does the industry need to wait? This plant, like the boiling reactor, depends on a long-burn-up fuel element. Unfortunately that is not yet available. The low fuel cost of 1.0 mills per kwhr is based on an exposure of 10,000 megawatt-days per ton. We aren't there yet, but will be.

"Our immediate contribution in this estimate is to provide the industry with a feeling of certainty that the capital investment will not be too large to preclude competitive atomic power."

Design features of Westinghouse-Duquesne project

Discussing the world's first large atomic power plant, the 60,000-kw installation near Pittsburgh, Charles H Weaver, manager of Atomic Power Division of Westinghouse, presented data briefed as follows:

The main coolant system, which serves both to absorb heat generated by the reactor and to deliver heat to the steam generators, will consist of four loops operating off the reactor vessel. Each loop includes a pump, a steam generator, shutoff valves and interconnecting pipe. The pump keeps cooling water circulating between reactor and steam generator.

The steam generator is a water-to-water heat exchanger, plus a steam drum and separator. Shutoff valves permit isolating one loop if it is not required, or repairing it while the other three are operating.

To prevent boiling, the primary water will circulate at about 2000 psi and an average temperature of about 525 F. Three loops can maintain rated plant capacity. The 2000 psi is maintained by a pressurizing tank that floats on the system and is connected to one of the reactor outlet pipes. This tank is normally filled with about equal volumes of water and saturated steam at more than 600 F. Electric heaters in the water maintain the head of steam.

A reactor core of slightly enriched uranium is arranged in a geometrical pattern of closely spaced fuel elements encased in noncorrosive material. The original core will contain more than 10 tons of uranium. These fuel elements, said Weaver, will be forced into a cylinder about 6 ft across and 7½ ft high.

The reactor is so designed that fuel elements of various shapes, and materials of various types, can be tried out

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The new SMA-00 and SMA-000 LimiTorque Valve Control is the latest and most advanced method of operating small valves, ranging from 1½" up to 8" in diameter. These units provide complete safety to workmen, by eliminating the need of climbing to high or hazardous locations for manual valve operation. The valve operating parts are protected by two limit switches ...One provides uniform valve seating thrust, giving positive protection to the parts from overload. The second switch is the geared limit, which controls the stem travel for both directions.

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MECHANICAL SEALS,
RUBBER EXPANSION JOINTS

ATOM POWER IN 10 YR

Continued from page 178

in future cores. The oversized dimensions of the container (a stainless-clad carbon-steel shell, 9 ft in inside diameter and 25 ft high) will permit useful experimentation.

The heat-exchange portion of the steam generator will consist of a bundle of stainless-steel tubes, the ends welded into heavy tube sheets. The entire assembly will be enclosed in a steel shell. Primary coolant will flow inside of the tubes. Steam evolved from water surrounding the tubes will rise to the steam drum and separator, and leave the drum at 600 psi saturated.

Westinghouse has ordered two of these generators from Foster Wheeler and two from Babcock & Wilcox.

The pumps will be single-stage centrifugal units driven by induction motors of the canned type to eliminate leakage and sealing problems.

The design will use the inherent stability of a pressurized water reactor to simplify control during power changes. The negative coefficient that can be designed into such a reactor core will automatically hold the water flowing through at a constant temperature. To retain any radioactive materials that might escape as a result of an unlikely accident the entire primary plant will be enclosed in a steel container. Reactor and heat exchanger will be underground in a concrete and steel structure.

Westinghouse Conclusions

Noting the high cost of enriched uranium, Weaver said that Westinghouse has chosen to use as little enrichment as possible. Likewise, ordinary ("light") water was chosen, because the limited advantages of heavy water did not warrant its high cost. Also, because fuel reprocessing is expensive, the design sought the longest life span for each core loading and the maximum use of converted material—that is, the maximum burn-up of plutonium produced as reactor operates.

"We do not claim to know," said Weaver in closing, "and we do not believe any one can justly claim to know, which reactor will ultimately turn out to be the most satisfactory. The evidence required for any sort of judgment is just plain lacking. For this reason, we welcome the Atomic Energy Commission's recently announced 5-year program—The Commission's policy of exploring five approaches that seem most promising today is certainly right."

Amercoat Corp, manufacturer of protective coatings, is now occupying new executive offices and a new research laboratory recently erected at its home office site at 4809 Firestone Blvd, South Gate, Calif.

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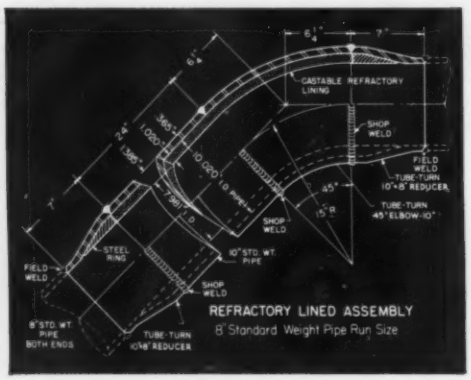
The general practice in handling highly abrasive materials in piping is to use heavy wall carbon steel elbows for directional changes, and replace these as they wear out. Recently, a new pipe lining . . . a zirconia-corundum refractory . . . was introduced with exceptional wear-resistant properties. This offers a highly satisfactory solution to the abrasion problem. The sketch shows how this lining can be applied to a 45° elbow by combining with two reducers.

This application is practical for piping of 4" through 12" diameter. Minimum thickness for casting of refractory is about one inch. It should be confined to mild pressure-temperature conditions. Additional details are available from Tube Turns' Engineering Service Division.



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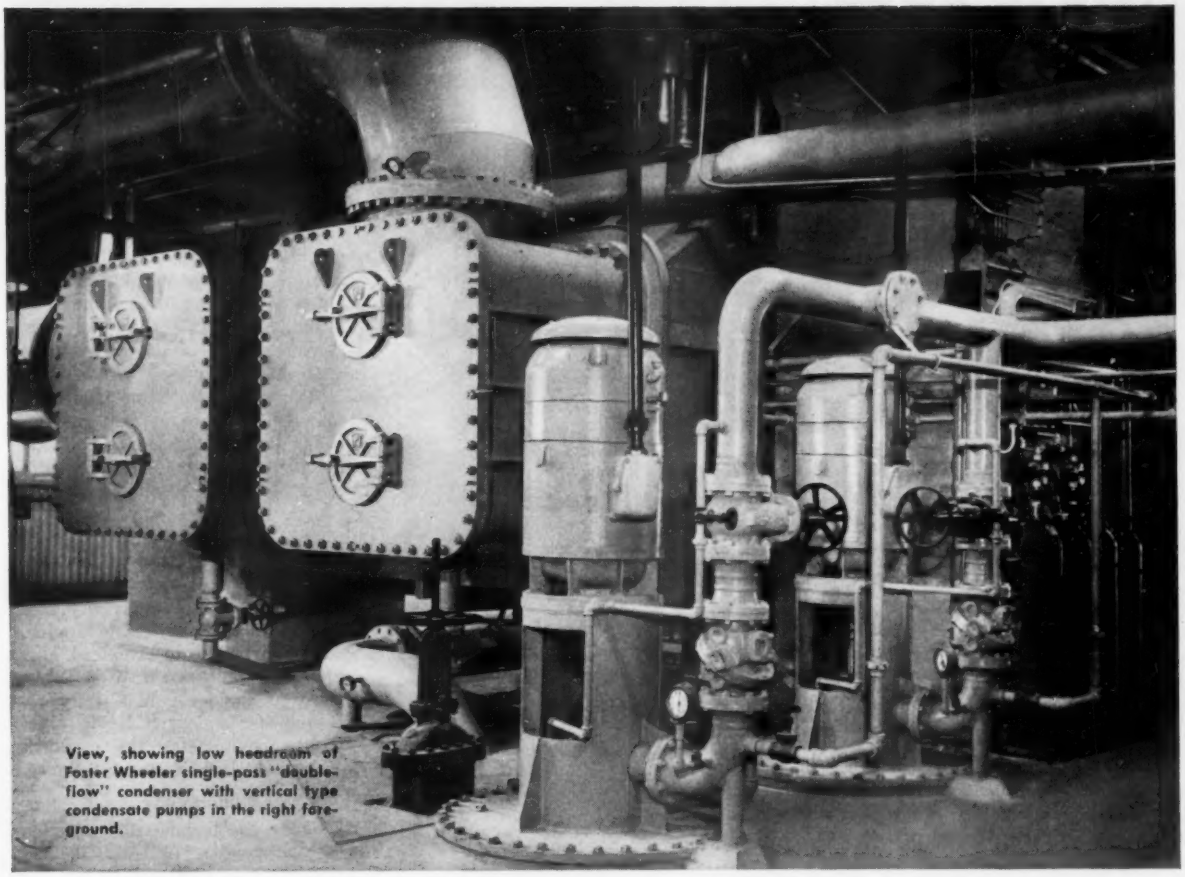

View, showing low headroom of Foster Wheeler single-pass "double-flow" condenser with vertical type condensate pumps in the right foreground.

New Foster Wheeler "double-flow" condenser uses 40% less headroom – cuts building costs – more than meets the highest performance standards

Utilizing a volume only 60% of that customarily required, the new Foster Wheeler "double-flow" principle marks a new advance in condenser design. Less headroom is required—often 40% less than the over-all height of conventional units. This means a proportionately shorter turbine pedestal—and a substantial reduction in building costs.

The rectangular shape makes possible complete utilization of the space available. Intimate contact and scrubbing action between steam and condensate promote effective deaeration and reheating. Condensate leaves the hotwell at steam temperature under all operating conditions. Also, because of the larger steam entrance and shorter tube-bank depth, pressure loss is reduced to a minimum. Efficient cooling of the non-condensate vapors and gases is provided by triangular cooler sections of the series zone type.

In a typical test of a 32,500 sq. ft. unit, the actual heat transfer coefficient showed 578 Btu per hr. per sq. ft. per F as against 510 for commercially clean tubes,—thus resulting in an absolute pressure 0.10 inch better than expected. Further details on request.

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165 Broadway, New York 6, N. Y.

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From a tough liquid handling problem to pumping just plain water, the new Deming Fig. 4011 series end suction centrifugal pump is "matched to the job" with the proper liquid end and proper power end.

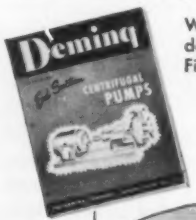
Many years of experience in centrifugal pump design have been incorporated in this pump to make it an outstanding addition to the Deming line of centrifugal pumps. Some of the many features are:—

Semi-open, non-clogging type impellers of extra heavy, three-vane construction; available with wiping vanes for handling special liquids.

Deep packed stuffing box with grease or water lubrication is furnished as standard construction. For special applications, various other types of stuffing box construction can be furnished including mechanical seals.

New four-piece separate liquid end assembly permits special construction in corrosion-resistant metals with the power end of standard material. Other optional features for abrasive or other special services can be supplied.

Sizes range from one through five-inch discharge with capacities up to 1000 gallons per minute and maximum heads up to 250 feet. Units are available with electric motor (as illustrated), gasoline or diesel engine driven, with pulley for belt drive or pump only.



Write for new Bulletin No. 4011 which contains complete details, illustration of construction and performance data on Fig. 4011 Deming End Suction Centrifugal Pumps.

THE DEMING COMPANY
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Specify DEMING PUMPS

GAS-TURBINE OVERHAUL

Continued from page 79

was raised to match available steam-turbine capability along with improving station heat rate.

There is no doubt that further refinements will be made in gas turbines. Only operating experience can bring them about. Lower maintenance expenses can be expected. The simplicity of the simple-cycle unit should continue to make it attractive when waste heat can be utilized.

The gas turbine definitely has a place among prime movers. It is likely that for sizes up to 2000 to 5000 kw, internal-combustion engines will continue to be preferred. Between 2000 and 15,000 kw, gas turbines seem ideal. Above these sizes, steam turbines will probably be used. There seems to be no immediate economy incentive to develop gas turbines for sizes at which modern high-temperature steam turbines are built. Also, up to now, gas turbines have been completely developed only for liquid and gas fuels.

Successful operation and maintenance of our gas turbines have been in no small part due to the supervisory staff and plant forces of Belle Isle Station. We particularly like to commend L D Husky, chief engineer; R W Baze, assistant chief engineer; W C Doty, results engineer; and R S Lewis, chief electrical operator for the excellent manner in which they have functioned.

Bibliography

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STEPS BEFORE STARTUP

Continued from page 93

blowback will usually have to be slightly higher than desired because the heavy, cool steam relieved with the boiler on bank will hold the valve open longer than will the hotter steam relieved with boiler under load.

Applying gags too tightly may cause sticking. Then valves will not pop at

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Straight through port design eliminates turbulence, lessens frictional loss and guards against erosion.

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STEPS BEFORE STARTUP

Continued from page 184

set pressure until opened by hand or over-pressure. Also, the stems may be bent, preventing proper operation.

For setting safety valves, mount a newly tested, accurate pressure gage at some convenient spot near the boiler steam drum. Install a "pigtail" siphon beneath it and run a pressure line to some point on boiler steam drum. Make proper allowance for water legs to give actual steam pressure at the drum.

Check the gage at firing level and adjust if necessary to show correct pressure at steam drum. Gag valves that are not to operate, and have boiler-water level close to normal when valves are popped.

Arrange a system of signals between boiler operator and valve-test man, so operator can reduce fires or cut them entirely after a valve pops. Do not adjust or gag valves until pressure recedes 5 to 10% below popping point.

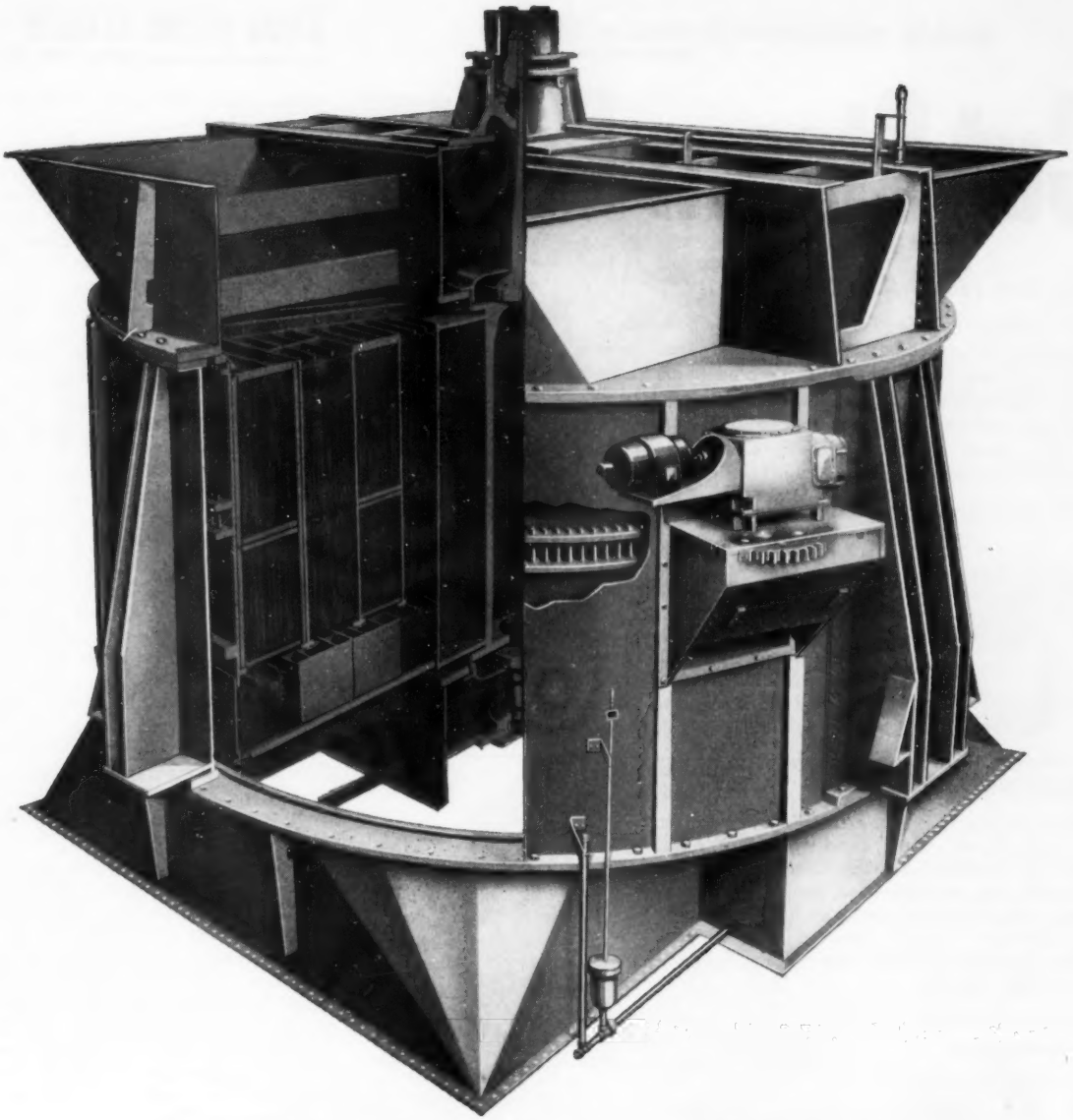
Successively pop each valve and adjust if necessary, until all have been tried; then lower pressure to a safe value and make additional trials of adjusted valves until you have all the desired settings. If a valve does not pop when pressure is raised to 2% above its maximum setting, open it by hand, then reset for a lower pressure.

Power control valves should be tried out three ways: (1) for electrical operation with steam shutoff valves closed, (2) by hand control while actually relieving steam, (3) on automatic control. Adjust popping pressure and blowback at the control box.

Killing the fire to drop steam pressure while setting valves may be inconvenient or unsafe. As an alternate, you can use the power control valve to reduce the steam pressure rapidly. But the frequent operation required may necessitate overhauling the valve, and it is generally more desirable to use the slower method of stopping and starting the fires.

As mentioned above, power-control valves with a relieving capacity much above 20% of boiler steaming capacity may hammer. This is caused by the sudden pressure drop in the superheater outlet header and the short blowback (1%) required. Valve closes quickly without actually dropping the drum pressure. Pressure then rises, valve blows, and the cycle repeats.

Blowout of steam piping. The main steam lead from boiler to header or to turbine-generator of main steam-consuming point is usually blown out at the conclusion of boilout. You need a heavy blow to remove all dirt and debris in piping, superheater and connecting



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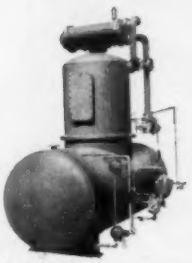

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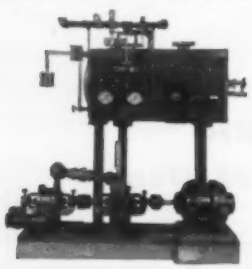

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A closed pumping system for returning condensate from heating and processing units to boilers at a temperature only 15 to 20 degrees lower than temperature of steam at operating pressure. Saves 10% to 25% of boiler fuel. Increases boiler capacity. Maintains higher, more uniform pressure. Delivers drier steam at higher temperature. Reduces raw make-up water and scale 85%. Bulletin 250.

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STEPS BEFORE STARTUP

Continued from page 186

steam piping. This avoids trouble later, during operation.

Check piping thoroughly before blowing, to see that it is properly supported and completely installed. Fabricate a special connection to top of turbine stop valve or some other similar point at the end of the steam lead; carry it to a point outdoors, where escaping steam will do no damage. Fasten this venting connection firmly with cables or clamps so it cannot move backward or whip about as steam escapes.

Make two or three blowouts, the first at 10 to 20% normal operating pressure, the second and third at about 50% normal pressure. If possible, use a motor-operated valve to control steam flow, with all other valves in the line open wide. Open gradually, hold for several minutes, then gradually close.

Before starting, boiler-water level should be a little low, as the high-steam flow will raise it considerably. Continue or increase firing during the blow.

Take precautions to prevent injury and property damage from escaping steam and debris. Be sure that all persons are warned to stay out of the danger area. If possible, it is always better to do this job after construction workers have left for the day.

Blow out smaller steam lines by removing a strainer or valve at the end of the line, then sending steam through at a heavy rate. Use a deflector to prevent damaging adjacent equipment.

During blowout you want steam flow somewhat greater than the expected maximum, and you need several temperature changes so all dirt and debris will be loosened and eliminated. Then it cannot cause trouble later when plant is in operation.

Procedure after boilout. When boilout is complete, safety valves set, and main steam leads blown out, kill the fires and slowly cool down boiler. Before pressure reaches zero, open boiler vents. Drain any time after pressure reaches zero. Open all blowdowns, including waterwalls, to remove the maximum amount of dirt.

When boiler cools to 140 F or lower, open drum and handhole covers and thoroughly flush all inner surfaces with a water hose before mud has a chance to dry. Carefully inspect the various internal parts to see that all grease and oil has been removed. If surfaces are still oily, repeat the boilout.

Check water tubes and waterwalls to see that no tubes are plugged. Restricted circulation is almost sure to burn out a tube under the high temperatures of full-load operation. Some successful

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Prevailing winds are the enemy of one induced draft cooling tower . . . the MARLEY SINGLE-FLOW. Instead, the wind is put to work by placing the one louvered face of the Single-Flow to utilize this source of natural cooling potential. Results: a high degree of atmospheric cooling that gives performance a substantial lift . . . a real power saving in day-to-day operation . . . a comfortable margin of safety in the event of power failure.

These are not theoretical advantages; they are facts obtained from tests in many plants in the Southwest and other areas. Winds of 10 to 15 mph will operate a high Single-Flow at near half design load with fans off, and near design load with fans at half speed. This means positive operating economy that every plant is seeking.

Another advantage of the Single-Flow is that with its one open side properly positioned, prevailing winds can not cause recirculation of warm, moist air. That is why Marley places no 7-mile-per-hour test restriction on the Single-Flow, but permits you to test your tower realistically under existing local conditions.

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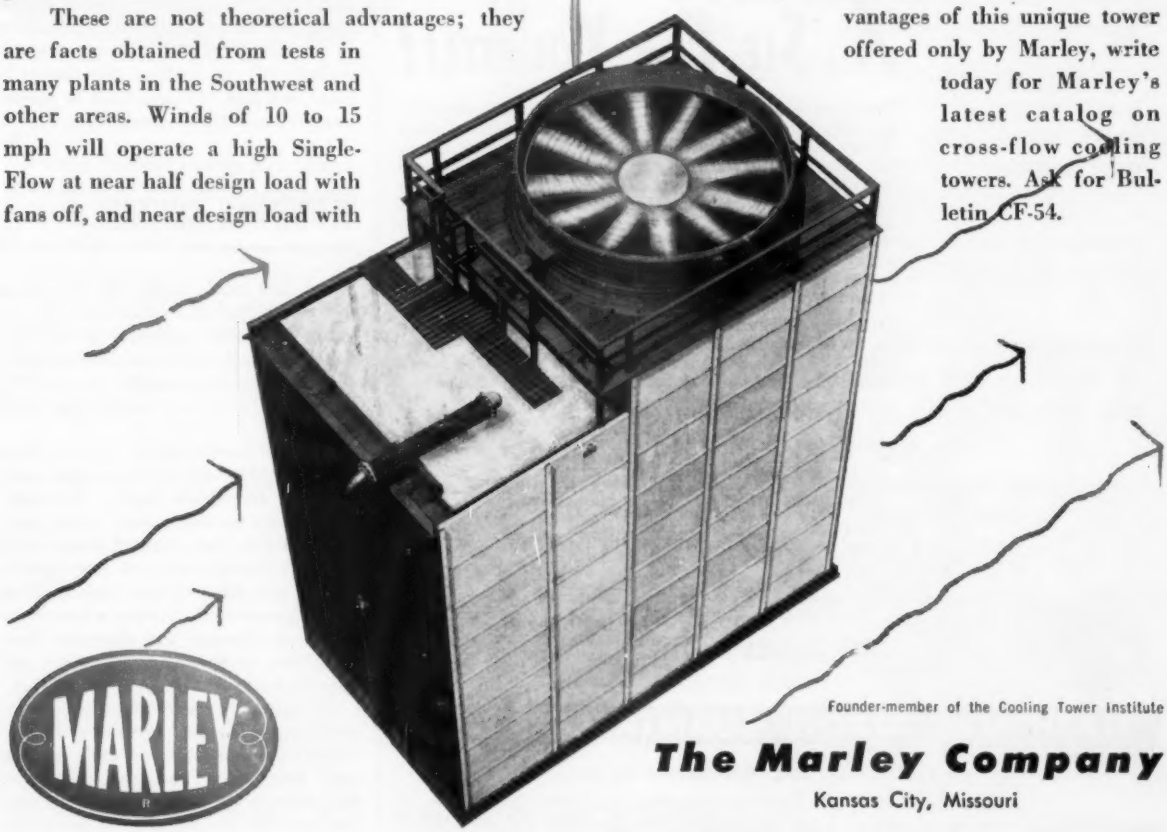

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

STEPS BEFORE STARTUP

Continued from page 188

ways to make this check are: (1) beam of light (2) good-sized water stream from a hose (3) steel ball on tape (4) hard rubber or wood ball, or steel nut dropped through each tube. Regardless of the method, take care to avoid losing the sounding pieces, and be sure workmen do not leave other debris to plug up tubes already checked.

Acid cleaning, protective coat. Boilers that are to be acid cleaned or internally covered with a protective coating require further steps after boilout. Consult the manufacturer for required procedure, to avoid repetition of some of the boilout steps.

Ordinarily, postpone installing drum internals until acid cleaning or coating work is complete. Lay the internals in the drum so they will be cleaned during boilout and acid treating. With internals in place, acid cleaning often causes leaks as the acid may affect asbestos gaskets in the baffle joints.

When internals are finally installed, carefully inspect all parts to see that there are no holes in gaskets, baffle plates or welds that will allow steam contamination. If you have a steam washer, be sure it is level.

Check steam sampling, water sampling, continuous blowdown, recirculating and chemical feed lines and nozzles to see that they are (1) properly installed (2) in correct location (3) clear and free (4) connected to proper lines (5) plainly marked.

BLOWDOWN CONTROL

Continued from page 117

above, and occasionally even as low as 400 psi, silicic acid volatilizes with the steam and later condenses as a sticky deposit on turbine blades. Hence higher blowdown rates are needed. But at 10%, blowdown becomes a costly item, fuelwise.

External conditioning. Where blowdown would otherwise become excessive, external correction helps. Naturally, this is more necessary with higher pressures because they demand lower solids limits. External treatment may involve merely softening, or may include silica reduction as well. System selected depends on physical and chemical characteristics of your makeup water and specific feedwater composition sought.

Sodium-zeolite softening often proves satisfactory for low pressures. It substitutes sodiums for raw water's calcium and magnesium hardness. Alkalinity and silica remain unchanged, however, and total solids content is not decreased.

Wear Control

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Just send your worn liners and cylinders to Van der Horst. If they've already been oversized to the limit, that doesn't matter. We can plate them all back to original bore dimensions with VANDERLOY M.

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Over the VANDERLOY M we plate PORUS-KROME*. It makes cylinders last as much as four times longer than they did when new and unprocessed.

Then, back they go, ready to give you efficient and dependable service, until at long last they need another Van der Horst processing.

Since the cost for all this is surprisingly less than the price for new, unprocessed replacements, we think you'll want to know more about our wear control method. Why not drop us a line? W52-1D

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BLOWDOWN CONTROL

Continued from page 190

Instead, it is actually increased 2 to 5%. Both boiler-scale formation and sludge buildup are greatly minimized. But with little hardness to consume them, boiler-water alkalinities are left to concentrate to considerable proportions. Thus, contrary to common belief, more blowdown may be needed with sodium-zeolite softening than without. In such cases, a hydrogen-zeolite exchanger or acid after-feed must be coupled with sodium unit.

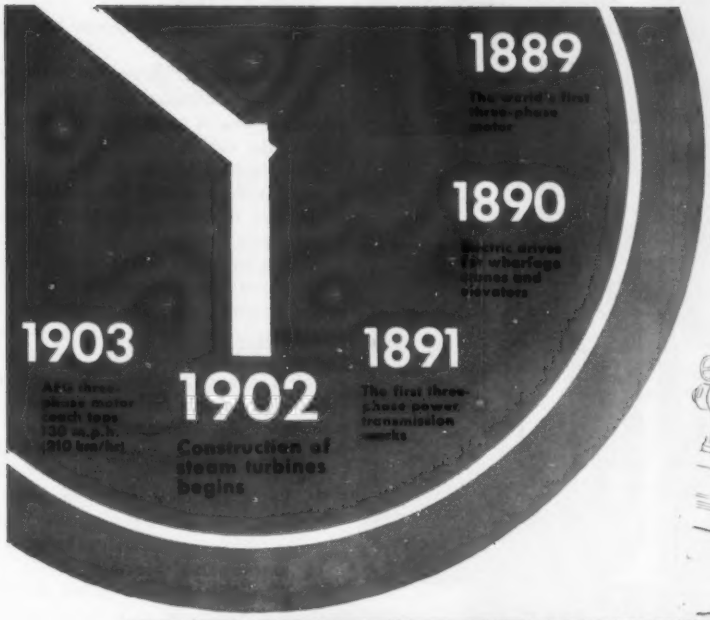
Lime-soda softening is well suited to moderate pressures. While it leaves some hardness unremoved, silica, alkalinity and other harmful ingredients can be appreciably reduced and total solids content lowered as much as 50%. For fairly high pressures, combinations of lime and zeolite, or lime-soda and phosphate are more suitable and for exceptionally high pressures, demineralization may be necessary.

Blowdown control. Except for the chloride ion, virtually all other feedwater chemicals suffer reduction, increase, or decomposition in the boiler. Only three metals—lead, mercury, silver—precipitate as chlorides. Lead alone is rarely found in natural waters. The chloride is expected to concentrate directly with the feedwater and, therefore, forms a dependable measure of the cycles of concentration the feedwater undergoes in the boiler.

To return to the example above, if feedwater chloride is 6 ppm, then under 20 cycles of concentration, boiler-water chloride will be 6x20, or 120 ppm. To maintain a 5% blowdown, we'll have to keep boiler-water chloride close to this figure, provided raw-water chemical composition and volume of returns are both fairly stable. When raw water suffers drastic seasonal changes, boiler-water chloride limit has to be revised accordingly. Where percentage of returns is variable, required cycles of concentration have to be based on raw-water chloride instead of feedwater chloride.

The chloride test is a simple titration, using a standard silver-nitrate solution (POWER, Dec 1947, p 93; May 1940, p 110). This test should be made daily, along with those governing the feed of chemical treatment. For high boiler pressures, such tests need to be run each shift. Periodic checks of steam purity and relationships between boiler-water suspended solids, dissolved solids, silica and other constituents with the set blowdown rate should be made.

To encourage private investments and speed up the electrification of rural areas and small towns, the Colombian Government has decreed freedom from municipal and state taxes for private electric works.



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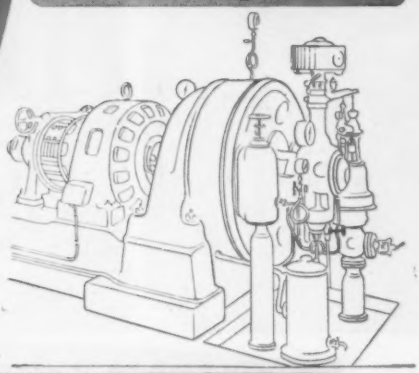

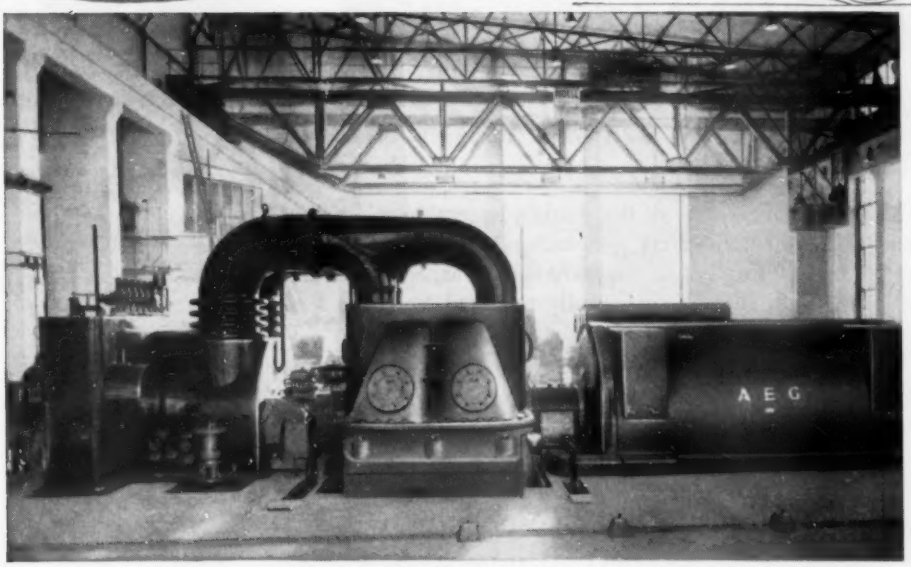

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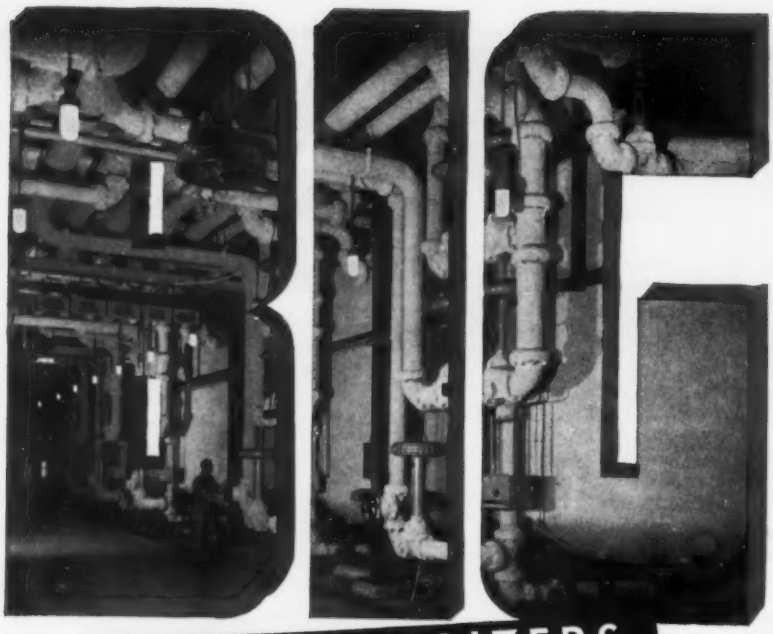

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THIS demineralizer, one of the world's largest, provides 100% makeup for 1250 psi boilers generating 1,200,000 pounds of steam per hour. Using Nalco ion exchange resins, Nalcite HCR® and Nalcite SAR, silica is successfully removed from the feedwater — as illustrated by the fact that after 75 to 100 concentrations, silica content of the boiler water is still *less than 5 ppm!*

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480-V LOOP

Continued from page 87

v transformers. These transformers are the conventional 240/480—120/240-volt air-cooled units with one exception: A center tap is provided in each of the 120-v windings. The two 120-v secondary windings in each are paralleled and the two center-taps grounded, holding maximum voltage to ground to 60 v. This is an added safety factor, especially where operators neglect to ground the frame of portable tools.

Branch circuits fed from these transformers are switched through 2-pole circuit breakers mounted in panels near the transformers. There are seven 10-kva and one 15-kva transformers of this type in the plant. Fixed motor loads on the 120-v system included forty-three ⅛ hp, twenty-two 1/20 hp, and one 1/30-hp unit-heater fan motors. Each is controlled by an individual manual motor starter and thermostat.

Other power loads. There are seven electric furnaces and three selenium rectifiers for process load. Furnaces include three 75-kw units for production work, and one 48-kw, one 35-kw, and two 27-kw units for tool and die making. Two 100-kw rectifiers and one 20-kw unit provides low voltage dc for *Alumiliting* equipment. Selenium cells in this rectifier equipment have aluminum plates and three ⅜ by 4 in. aluminum bus bars for positive and negative buses.

Lighting load. Designed lighting intensity was 50 fc for areas having rivet headers, thread rollers, slotters, automatic screw machines, lathes and drill presses. The same lighting intensity was planned for all inspection areas. A 35-fc intensity was planned for storage sections, aisles, furnace areas, washing, cleaning, and shipping areas. Lighting for the loading and unloading docks was designed for an intensity of 10fc.

Power for the lighting load comes from single-phase 240/480—120/240-volt transformers, tapped into the 480-v distribution loop through molded-case 2-pole breakers having two thermal overloads. There are eleven 37½-kva lighting transformers, two 25-kva, and three 15-kva. Each transformer secondary feeds a lighting panel that distributes to various lighting circuits.

All lighting in the plant area is switched from panels. In the office building, individual fixture runs are controlled from wall switches. No. 10 aluminum wire with TW insulation is used for lighting branch circuit wiring. Fixture troughs were used for portions of the raceways. Maximum of eight 3-lamp or twelve 2-lamp fixtures were connected to each circuit.

(*Continued on page* 196)

Sure, that old pump still works,

but how much does it cost to keep?

That rugged old pump of yours may not be the bargain that it seems. Let's do some arithmetic. If the efficiency of the old pump is 75% vs. the 85% efficiency of the new pump, you are paying more to keep it than you would to replace it. That's because a new unit of equivalent output uses less power. Thus it soon saves its own cost — then begins to pay dividends.

Let's take a specific example — a small boiler feed pump

Old pump efficiency 63% . . . . . 99.5 BHP
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8.5 BHP Saving

On the basis of 1¢ per KWH, the 8.5 BHP saving for 8,760 hours (a year of continuous operation) amounts to $560. This saving, capitalized in 10 years at 4%, adds up to $6,700. Yet the price of the new pump that saves $6,700 is only $1,101.

What would the pump replacement profit be in your particular case? Your De Laval representative can tell you exactly — in dollars and cents — as soon as he has the basic facts on your present installation. Call him in today or write to De Laval for Pump Fax Bulletin which includes a valuable "power-savings" chart.

DE LAVAL *Pumps*

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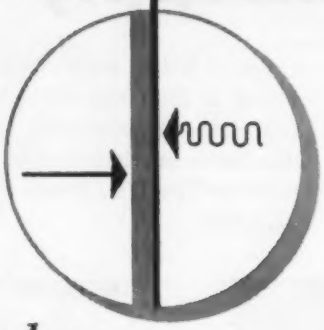
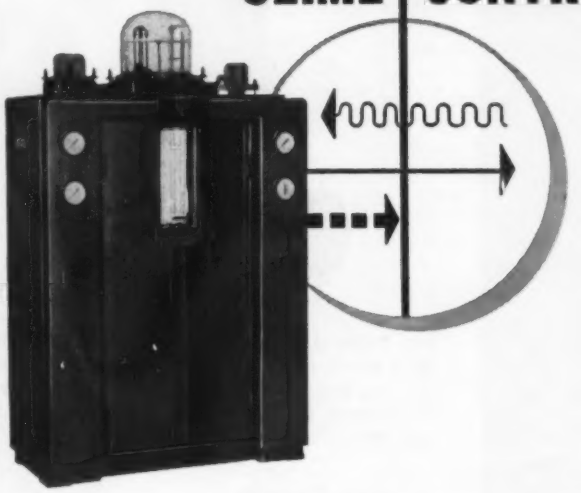


Be sure you have

SLIME | CONTROL



Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

WALLACE & TIERNAN

25 MAIN ST., BELLEVILLE 9, N. J.

CHLORINATORS • CHEMICAL FEEDERS • SCREENING EQUIPMENT • MAGNETIC SEPARATORS • PRECISION PRESSURE INSTRUMENTS • CATHODIC PROTECTION • FINE CHEMICALS

CD-39

More PLANT PROBLEMS

Begins on page 130

duties. This reduces disputes over work loads.

Our organization basically parallels that in *CC's* plant. As diagram, p 132 shows, the chief is responsible for all plant work, but has department heads who answer to him. Both plant operation and maintenance require accurate records and know-how. Also, a man must be familiar with both these phases to make intelligent purchases.

Our operation chief is boss of the entire setup when the chief engineer is away. He also handles routine complaints about service. These complaints may originate from white-collar department heads or from the plant itself.

Power, heating and plumbing come under one man because the operations are closely interconnected and the work tools are much the same. This gives better coordination of all these services throughout the year.

The maintenance chief is responsible for all routine and emergency jobs, including oiling, cleaning, etc. Air and refrigeration are consolidated in one group because controls are almost identical and our air and refrigeration lines are usually in the same tunnel.

Water-supply equipment is handled by a separate crew under the direction of the maintenance chief because the operation is so large.

L W FITZPATRICK
Jefferson City, Mo.

PERSONNEL NEEDS vary during the life of the plant. In the first five years, maintenance and repairs are relatively minor in a well-designed and well-constructed plant. During this time it is smart to set up accurate records and logs of operation.

If a union exists in *CC's* area, titles and classifications will probably have to conform to a union contract. Organization in chart, p 132, is flexible enough to allow for expansion of plant facilities. General practice assigns about 12 men to each foreman.

C G HOWARTER *Canton, Ill.*

MY CHART shows the organization *CC* needs in his plant, and the various job titles. Right now he is in an ideal position to enlist the aid of his local union representative, if one exists, because this may eventually be necessary. Titles can be set up to correspond with those for similar jobs in the area. Today, union officials are anxious to cooperate with plant executives who need help in organization planning.

Duties are allocated as follows: Chief engineer is in charge of all operation and maintenance. He sets up engineer-

Anticipate production needs with reliable electric power distribution

Meet H. G. "Barney" Barnett, Westinghouse Power Distribution Engineer, who points to 3 ways Westinghouse can help you by . . .

1. **Expanding power facilities**
2. **Engineering power distribution**
3. **Getting power to the load more efficiently . . . and by providing field service in depth**

In the face of changing production lines and increased machine capacity, you may feel like you're asked to "catch and play shortstop" to maintain reliable power distribution. It's an even tougher problem today with competition requiring more efficient operation . . . fewer power failures.

The answer to these problems in your plant may lie in a modernization or an expansion of one section of the power system or in a complete redesign of the system. Whatever the case, Westinghouse can field a team of experts to help in the early planning stages. They follow through, too, in coordinating the design, engineering, manufacture, delivery and installation of all the electrical equipment you'll need to do the job. Let's take a look at some answers the Westinghouse team can provide you with to improve power generation and distribution.

Next page, developments in expanding reliable power
Page 1 of 8 in this section

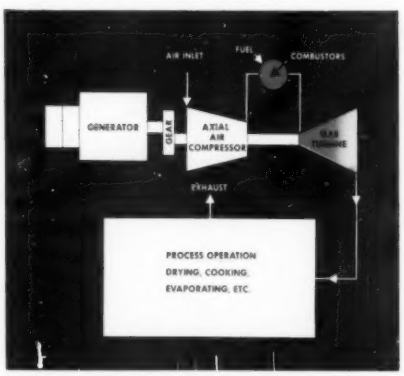
Whether installed by itself, or in conjunction with an existing power plant, Westinghouse Gas Turbine Power Plants are proving to be flexible, dependable prime movers . . . simple to install and operate.

Gas turbines provide dependable industrial power generation

Westinghouse Gas Turbine Power Plants offer a proved, reliable way to meet your expanding power needs. When installed in an existing plant, generating capacity and over-all plant efficiency can be greatly improved at the same time. This is especially true when you use the gas turbine exhaust for feedwater heating, supplying combustion air, or supplementary steam generation in a waste heat boiler.

Available in standard ratings of 1250, 3500, 5000 and 15,000 kw, Westinghouse Gas Turbines are easy and inexpensive to install, requiring only a light foundation and very small floor area. They're equally simple to operate, needing minimum personnel and maintenance. These are some of the sound reasons why gas turbines eliminate many of the problems attendant to other power generation methods.

Before you select any generation equipment, get all the facts from your Westinghouse Salesman.



Installed independently, the Westinghouse Gas Turbine Power Plant becomes a dependable single source for both electric power and large quantities of process heat.

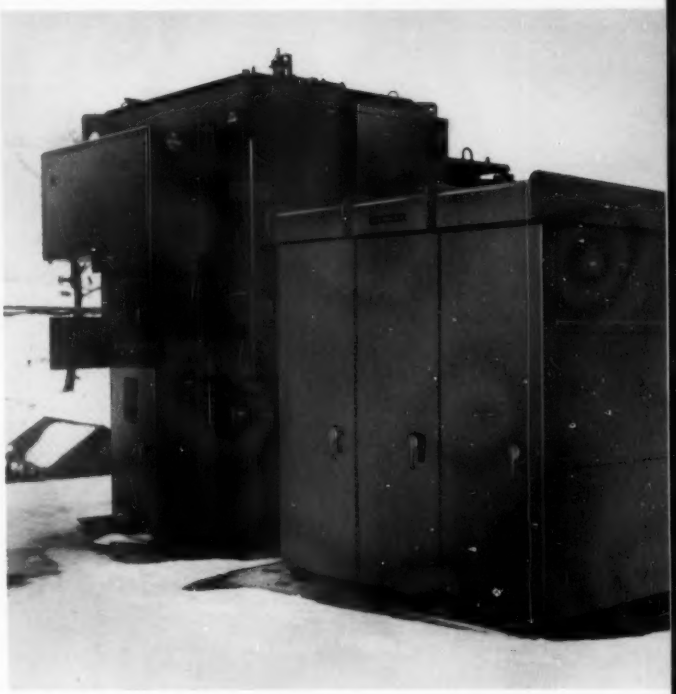
Unit substations easily expand system protection

Let's look at how you receive electric power at your plant. Too often the transforming and switching ability of this vital link is not flexible enough to afford protection that is able to grow with plant needs. That's why Westinghouse Unit Substations offer a very fundamental answer to continuing power distribution protection.

First, the load capability of the unit substation can be readily adapted to accommodate load growth and shifting load centers. Addition of a feeder is a simple matter of adding the compact switchgear unit. A transformer can be changed out readily when necessary. An entire substation can be moved easily and economically, too, with minimum disturbance to service and no sacrifice of protection.

Second, installation is simple. All you have to do is lay a foundation, throat-connect cubicles to the transformer, and tie in feeders. Savings in time and labor are substantial, compared with field-assembled equipment.

To sum it up, the Westinghouse Unit Substations provide the flexibility and dependability vital to protecting the present load as well as future changes in load requirements. They are the first step in assuring you the greatest return and long-time usefulness from your system investment.



Westinghouse Unit Substation Transformers and High-voltage Switchgear are engineered to work and fit together from the design state through manufacturing.

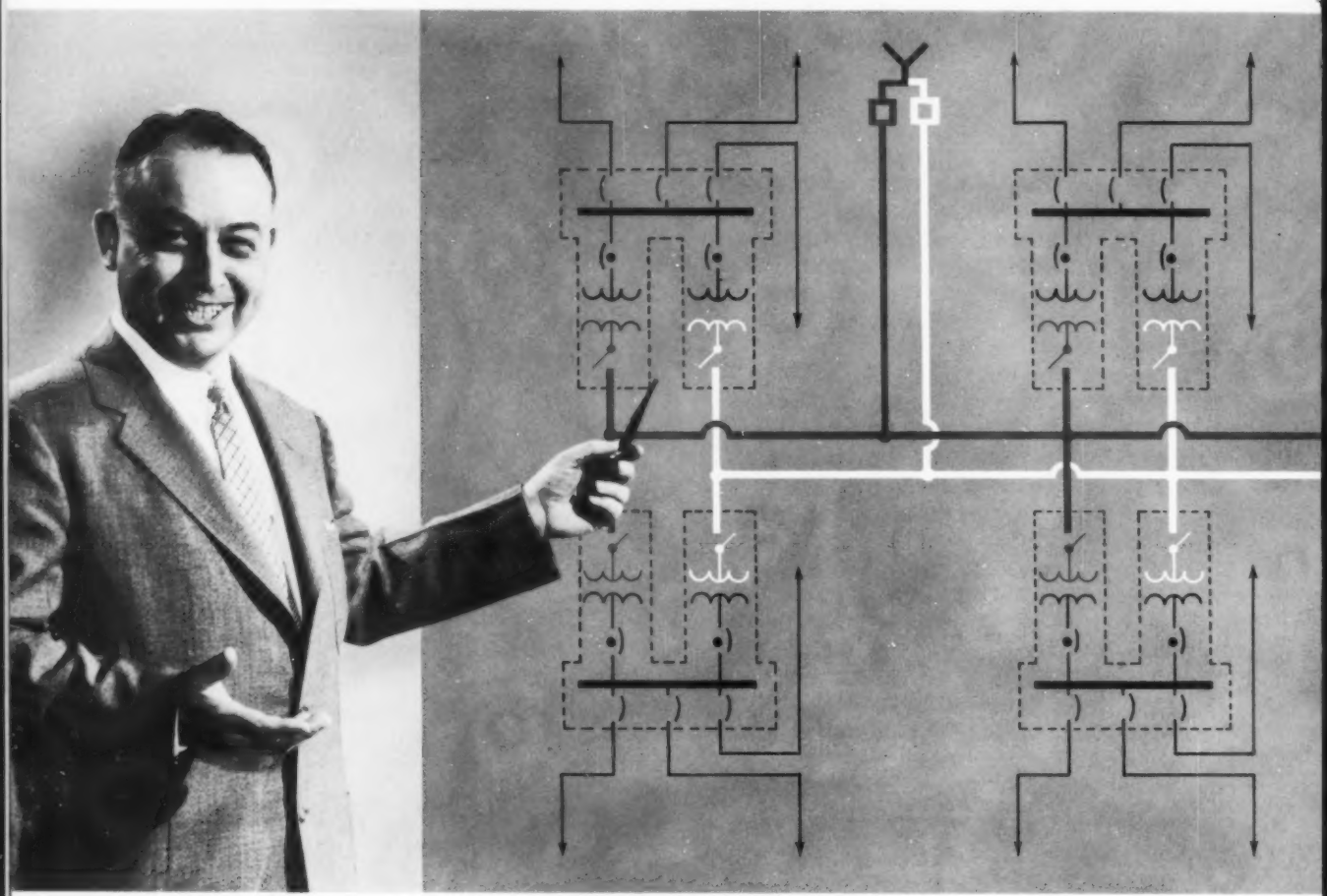
For service continuity, replacement of breakers is only a matter of minutes in Westinghouse Standardized Metal-clad Switchgear. High-voltage DH, De-ion® breakers draw out horizontally. Breaker units in the same voltage classes are interchangeable to provide adaptability to growing load.

YOU CAN BE SURE...IF IT'S

Westinghouse

Next step, engineering system reliability . . .

In this simple spot network system a primary feeder or transformer fault is automatically localized. In the event of a fault on one feeder (white), the other feeder and transformer (red) take over the load. Service continuity is maintained.

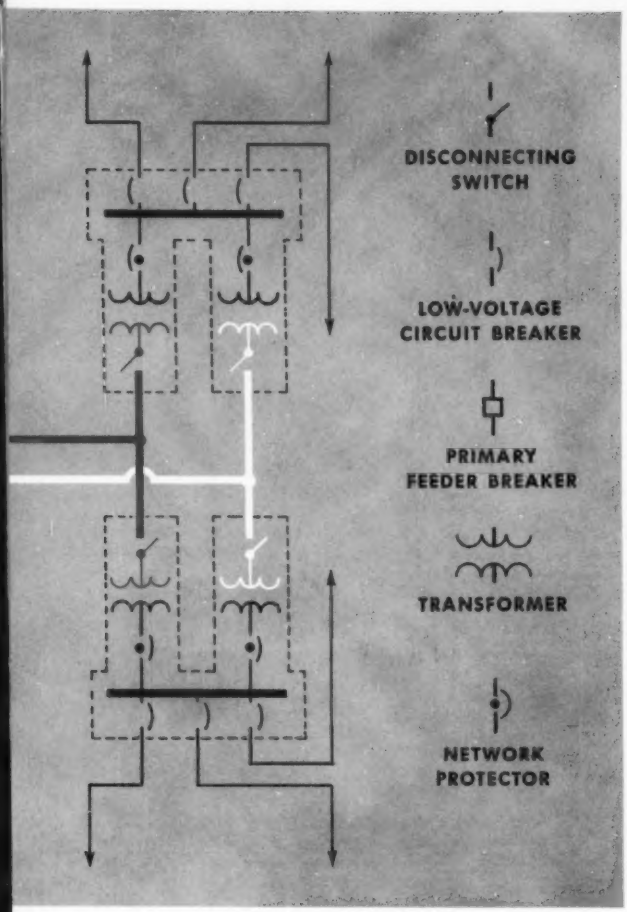


Coordinated equipment gives you more protection per dollar

If you're questioning how to get more dependable power distribution, let me suggest one way . . . a network system. Why? Simply because a network divides the load responsibility among power centers that, grouped together, form the basis for the electrical system. By coordination of this apparatus, a fault at any one point in the system can be localized and repaired while the rest of the system carries the load. It's electrical system team play that results in maximum protection.

For example, this simple spot-network system provides excellent service continuity and voltage regulation. *In the event of a transformer or primary feeder fault, the other primary feeder and transformer automatically take over the load.*

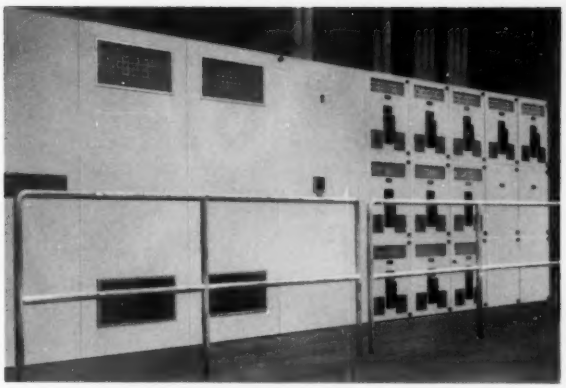
Network protectors are the heart of this automatic operation. They connect the transformer and primary feeder to the power center load bus. The protector avoids system shutdown by automatically interrupting power from a faulted transformer or feeder line and transferring the load to the unfaulted transformer at the power center. Thus service



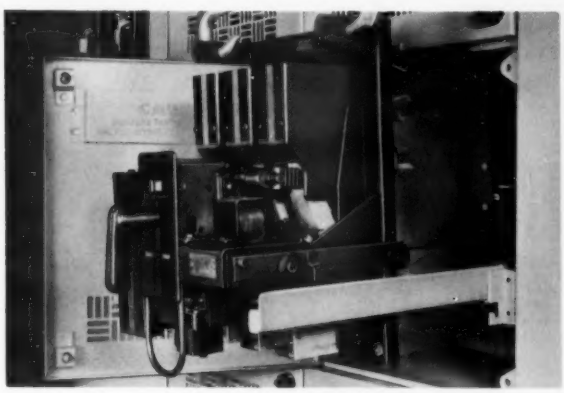
continuity is maintained without the cost of connecting power center load buses together with a loop circuit.

Specific savings result. In addition to providing excellent service dependability, the simple spot network adds the benefits of bringing high voltage right up to the load-area power center. Long, heavy secondary lines are cut down. You save substantially in copper. Power losses from over-extended secondary lines are eliminated and voltage regulation greatly improved.

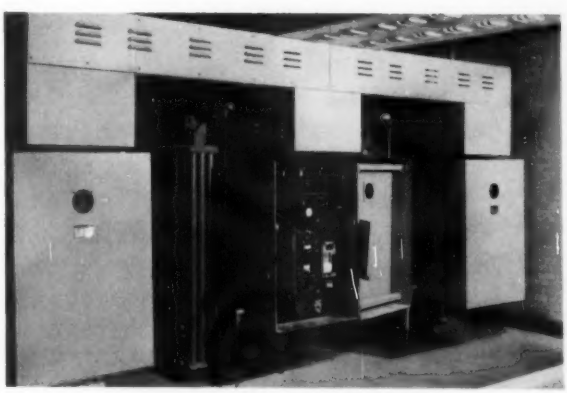
Network protectors connect transformers in parallel to the power center load bus. In the event of a fault, the protector isolates the faulted transformer and transfers the load bus to the other transformer and feeder to maintain service.



Balcony-mounted power center conserves plant floor area for production. No vaults or enclosures are needed for Westinghouse Dry-type Power Centers, cutting installation costs about 25%. Hipersil® transformer core reduces weight as much as one-third.



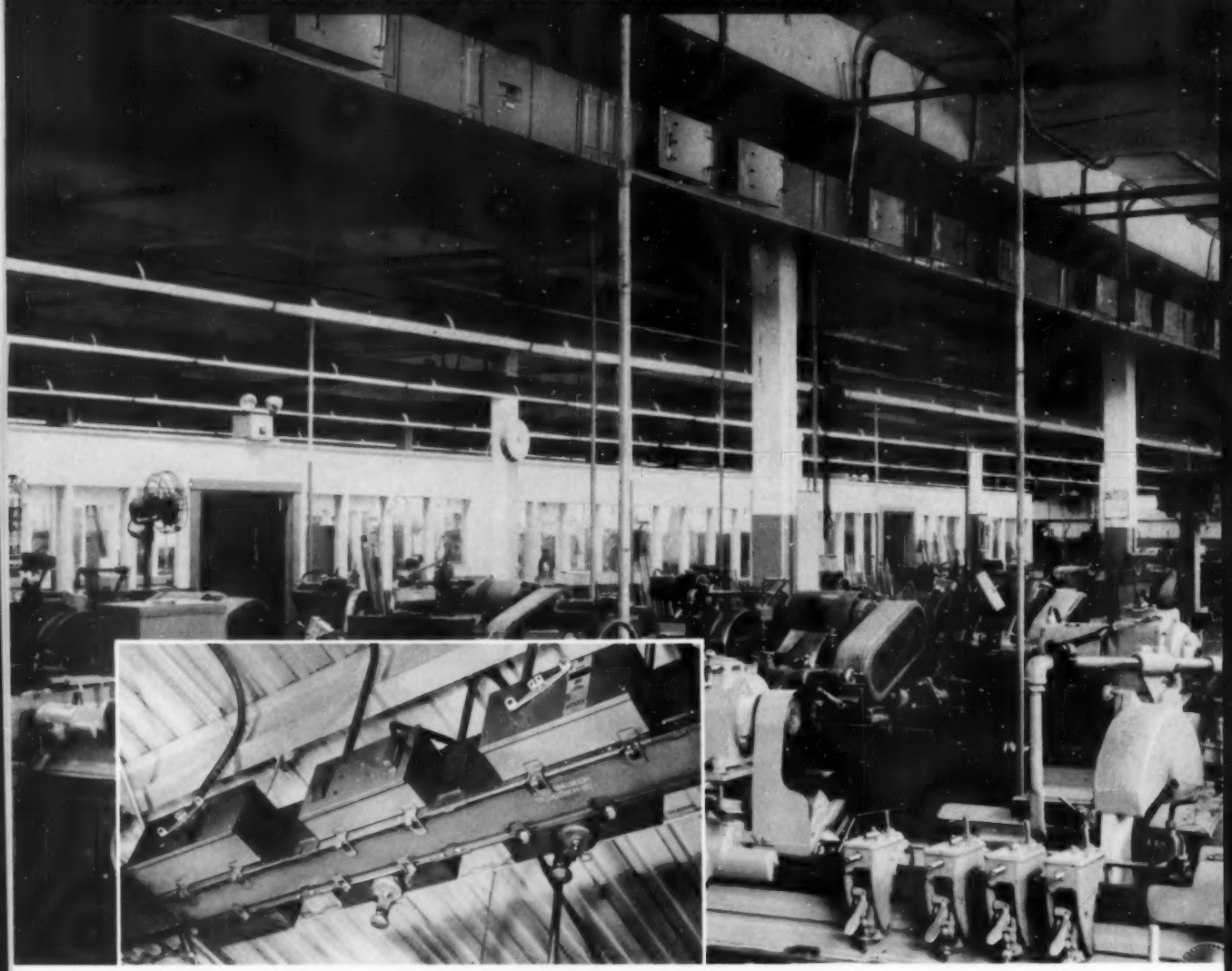
More protection in less space. Low-voltage DB breakers contain a multi-purpose tripping device to prevent false shutdowns. It provides: (1) delayed tripping on temporary overloads; (2) trips on larger overloads before damage is done; and (3) trips instantly on short circuits.

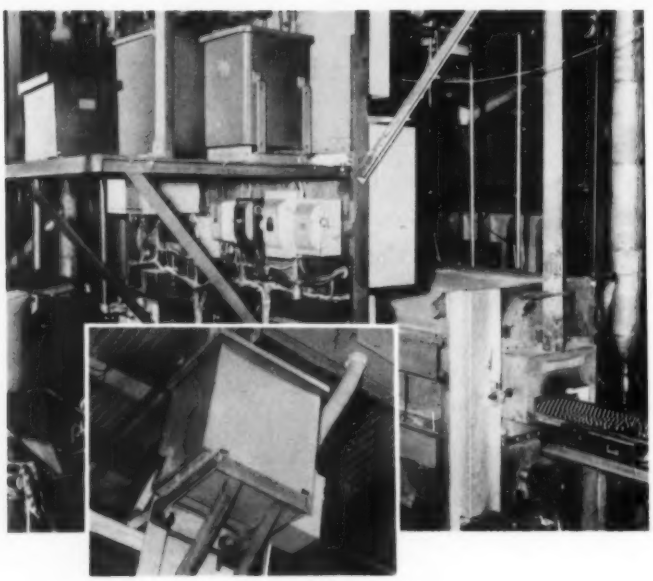


Westinghouse

Here's reliability in getting power to the load more efficiently . . .

RELIABILITY IN GETTING POWER TO THE LOAD MORE EFFICIENTLY





With bus duct, down time per operator was cut to 5 minutes in a Massachusetts tool company plant when 139 machines were relocated. Flexibility of plug-in devices made this possible. Insulated plug-in openings allow workers to install take-off devices quickly and with complete safety.

"With Westinghouse Dry-type Transformers we don't worry about costly shutdowns," reported the maintenance engineer of an eastern company. "On-the-spot power is available for our heat-treating department." Platform or column mounting saves floor space and long, costly secondary runs.

YOU CAN BE **SURE**...IF IT'S

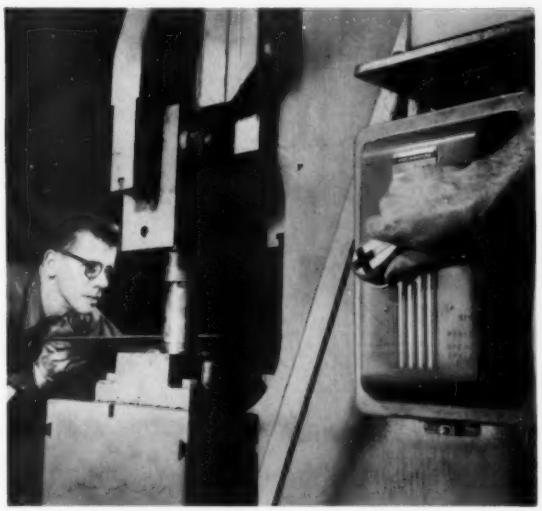
Here's how these plants limit down time

Three-shift electrical protection is critical today—critical in sustaining full production, critical when maintenance men may not be available to correct an unpredictable outage. Down time and maintenance costs can cut back plant profit seriously. Here's how Westinghouse products can help:

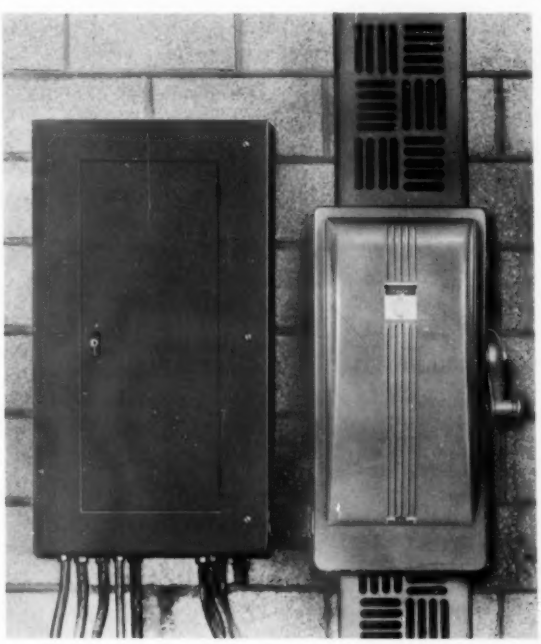
Westinghouse Plug-in Bus Duct, for example, speeds production-line change-overs. It permits quick addition of new circuits, easy transfer of old ones. Prefabricated in sections, bus duct goes up faster than cable and conduit. Savings in installation frequently reduce the original cost below that of any other secondary power distribution equipment. In addition it is readily salvageable, dismantled, reassembled and expanded.

AB-I circuit breakers minimize shutdown time three ways: first, they will not interrupt power on temporary, harmless overloads. Second, when the line is cleared after a heavy overload, power is restored simply by a flip of the handle. There is nothing to replace, no running after fuses. Third, there is no danger of over-fusing or under-fusing. AB-I circuit breakers preserve precise calibration throughout the life of the installation.

Westinghouse Dry-type Transformers virtually eliminate maintenance problems ordinarily connected with transformers. There are no liquids to store, recondition or replace; no valves, no gaskets or gauges to get out of order.



AB-I circuit breakers cut down time, saved over $1000 a year for a Massachusetts company. Previous power failures on induction heating equipment ran to $1000 and $1500 yearly. Now, AB-I circuit breakers prevent loss of material in process and lost-time pay.

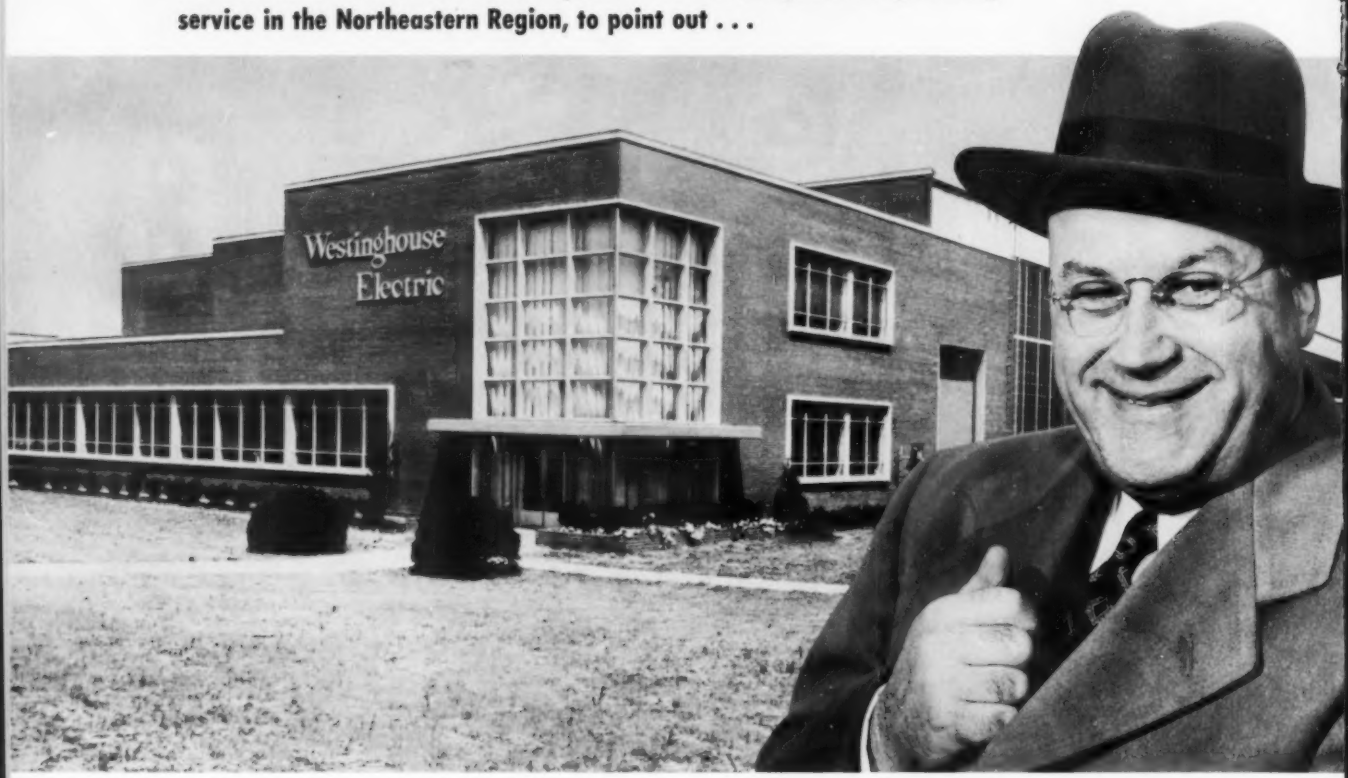


Safety switch and panelboard combination improved flexibility for this Midwestern company. Westinghouse Add-A-Cirkit Panelboards save space, provide room for expansion.

Westinghouse

Next page, how you benefit from Westinghouse field service in depth . . .

Here is M. L. "Matt" Gardner, responsible for Westinghouse engineering service in the Northeastern Region, to point out . . .



Your power problems are local . . . so is Westinghouse field engineering

The many Westinghouse engineering service people, like myself, are your link with a network of Westinghouse services. One phone call to us adds a complete engineering service team to your staff.

Consulting and application engineers can speed equipment installation time, eliminate problems right from the start. They work with your staff, help match the correct product to the job. They not only install Westinghouse Equipment, but test it to assure proper operation.

Manufacturing and Repair Service Plants—There are 38 of them strategically located in major industrial centers. Engineering and service are always available to repair your equipment right in your own plant, too.

Backup, spare parts inventory—Westinghouse Renewal Parts Warehouses are located in 31 industrial centers. They're open 24 hours a day. You can get replacement parts fast, and where you need them.

* * * * * *

For further details your Westinghouse Representative will be glad to answer any questions you may have concerning information in this section and get you a copy of the literature listed below, or write to Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pa.

ASK FOR

- ☐ Gas Turbine Power Plants **B-5887**
- ☐ High-Voltage, Metal-Clad Switchgear **B-5306**
- ☐ Low-Voltage, Metal-Enclosed Switchgear **B-5282**
- ☐ Dry-type Transformers **B-5920**
- ☐ Bus Duct **B-5835**
- ☐ AB-I Circuit Breakers **B-5456**
- ☐ Safety Switches **B-5457**
- ☐ Panelboard Planning **B-5260A**
- ☐ Control Centers **B-5621**
- ☐ Capacitors **B-3966A**
- ☐ Current-Limiting Reactors **B-5918**
- ☐ Preventive Maintenance Booklet **B-5477**

. . . and ask for a showing of the 20-minute film "Selecting the Right Industrial Distribution System."

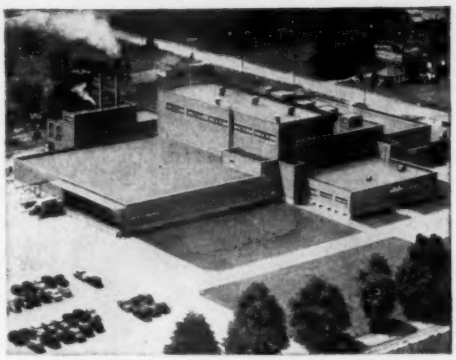
YOU CAN BE **SURE**...IF IT'S **Westinghouse**

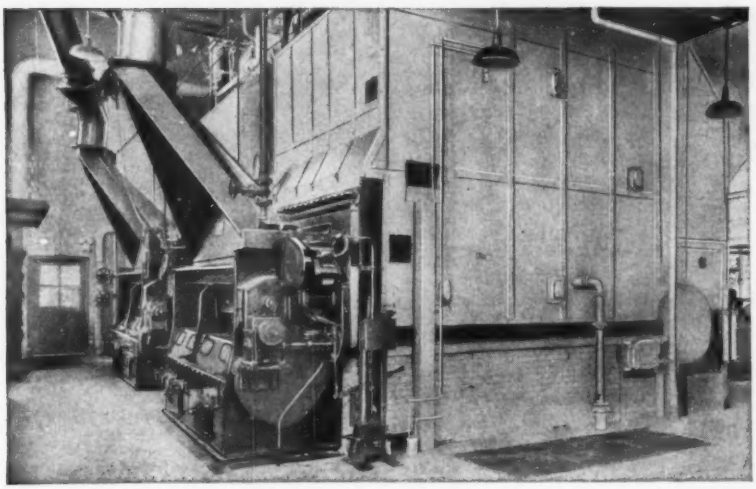
MP-301

"COAL'S BEST FOR OUR MODERN PLANT!

It's low in cost . . .
It's clean and convenient!"

says G. W. Peters, Engineering Manager
M&R DIETETIC LABORATORIES, INC.
makers of PREAM & SIMILAC





"We made a careful study of fuels and burning equipment before building our modern new plant in Sturgis, Michigan. This plant was designed to produce baby food. So the steam plant has to be clean and dust-free as well as economical to operate. Also, we wanted a fuel we could store safely and easily in order to insure ourselves against any shortages.

"We decided on bituminous coal—and the up-to-date installation shown here. It certainly fills the bill on every count. Our modern combustion equipment makes coal far more economical than any other fuel. Up-to-date coal and ash handling give us convenient operation completely free of dust nuisance."

Additional case histories, showing how other types of plants have saved money by burning coal the modern way, are available upon request.

Discover for yourself the great advantages of coal burned the modern way. Call in a consulting engineer. He'll show you how today's combustion equipment can give you 10% to 40% more power from a ton of bituminous coal than from equipment used only a few years ago. He'll show you how modern labor-saving coal and ash-handling equipment make a coal-fired installation clean, convenient, and dust-free.

If you plan to remodel or build a new plant, be sure to look into the low cost and convenience of bituminous coal. Consider coal's other advantages, too. It has reserves that are virtually inexhaustible. America's bituminous coal mining industry is the most efficient and productive in the world. With bituminous coal, you can be sure of plenty of fuel at relatively stable prices now and for years to come.

If you operate a steam plant, you can't afford to ignore these facts!

BITUMINOUS COAL in most places is today's lowest-cost fuel, and coal reserves in America are adequate for *hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

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A Department of National Coal Association
Southern Bldg., Washington 5, D. C.

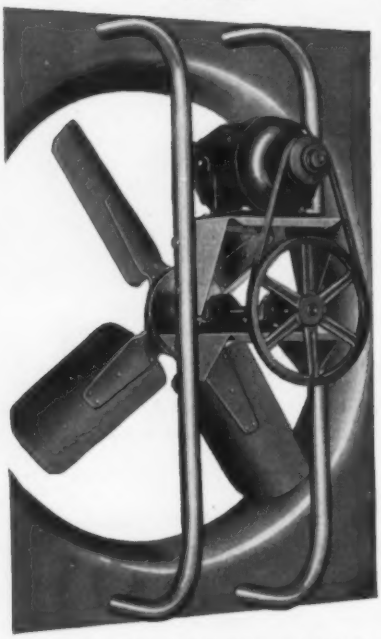
FOR HIGH EFFICIENCY FOR LOW COST

YOU CAN COUNT ON COAL!

INDUSTRIAL
Air Moving

FAST
ECONOMICAL
TROUBLE-FREE

Peerless PVB



● Peerless PVB Industrial Exhaust Fans are designed for low initial cost and continuous trouble-free duty. Complete ball-bearing construction with totally enclosed motor permits vertical or horizontal mounting. Peerless PVB's move air fast and may be used with ducts. They are sized with 24" to 48" fans. Pulley adjusts for lower fan speeds. Shutters and pent. houses also available. Your Peerless dealer can help you select the best PVB for your needs. If you don't know him — write, wire or call us.

Peerless Electric
THE PEERLESS ELECTRIC COMPANY
FAN AND BLOWER DIVISION
1417 W. MARKET ST. • WARREN, OHIO

More PLANT PROBLEMS

Begins on page 130

ing department policies and correlates his work with that of all other departments in the plant.

The assistant chief engineer supervises engineering operations, keeps records, schedules routine maintenance, and is responsible for water-treatment equipment and automatic controls. The maintenance foreman supervises the maintenance crew and keeps records of all machinery outside the engine dept.

Shift heads are in charge of a watch, keep logs, make flue-gas analyses, and supervise after-hour maintenance. Shift maintenance men work with maintenance or operating men, as needed on the day shift. They also take care of after-hour maintenance. One plant electrician is enough if motor rewinds are sent out.

Apprentices make replacements for men who leave, change jobs, or are promoted. Supervise apprentices carefully, keeping only those who show promise.

HOWARD HOLCOMBE
Los Alamos, N. M.

Coolant-oil pumps

Continued from page 134

low maximum detention time to permit contaminants to settle out.

Corrosion can be reduced by selecting a suitable cutting fluid. Consult an oil company or the tool builder for recommendations.

H B WAYNE *Brooklyn, N. Y.*

CONTINUOUS PURIFICATION by filters, often fuller's earth, removes suspended matter as it is formed. Make periodic tests to determine the acidity of the oil and the condition of the additives.

A A HUNNEWINKEL *Woodstock, Ill.*

USE A SETTLING TANK, heating the oil before it enters tank. This reduces viscosity of the oil and permits faster settling of metal chips and other impurities.

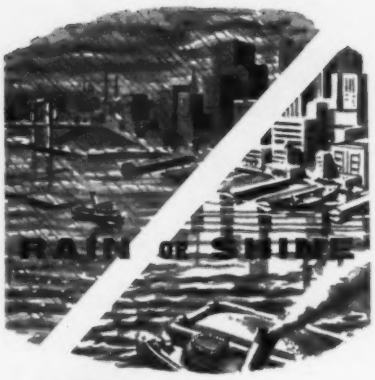
Arrange tank so the oil makes two or three passes through it. Use permanent magnets to collect ferrous materials in the stream. Fit a dual strainer to insure maximum removal of impurities. Cool the oil before returning it to the system. Thermostats can be used to keep the oil at a constant temperature.

J C FERRANTE *Bronx, N. Y.*

IF OIL SUPPLIER knows what metals *MV* is cutting, he can specify suitable additives to reduce corrosion to a minimum. He may even recommend a change in the oil used.

C G HOWARTER *Canton, Ill.*

(*Continued on page* 210)



Ferri-Floc
FERRIC SULPHATE

Answers
Your Water Treatment Problems

Regardless of the weather, your water treatment problems, or the degree of turbidity of your surface water, Ferri-Floc, as a superior coagulant, will meet your water treatment requirements. Ferri-Floc is a partially hydrated Ferric Sulphate which converts high turbidities without radical dosage changes. Only mildly hygroscopic, it can be stored in closed hoppers over long periods of time . . . permits safe and easy handling.

You Can Expect These Advantages:

- Rapid Floc Formation
- Ease of operation
- PH correction
- Bacterial removal
- Taste and odor control
- Manganese and Silical removal
- Color removal
- Turbidity removal
- Softening
- Economy

Water Treatment
Coagulation of surface or well waters. Aids taste and odor control. Effective in lime soda-ash softening. Adaptable to treatment of nearly all industrial water or wastes.

Sewage Treatment
Coagulation of wide PH range. Efficient operation regardless of rapid variations of raw sewage. Effective for conditioning the sludge prior to vacuum filtration or drying on sand beds.

SULPHUR-DIOXIDE SO_2

COPPER SULPHATE

SULPHUR-DIOXIDE
Is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER SULPHATE
Will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

Samples, Specifications and Detailed Information on Request.

TENNESSEE CORPORATION
617-629 Grant Building, Atlanta, Ga.

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FLASHING LIQUIDS?

THE ANSWER IS
THE *EXCLUSIVE*

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FLASH-FLO PLUG*

Another Famous Hammel-Dahl First

ELIMINATES...

- DESTRUCTIVE VIBRATION
- TRIM DETERIORATION
- HIGH NOISE LEVEL

Interchangeable with standard trim in = % or linear characteristics

Complete Information in Bulletin 101-B

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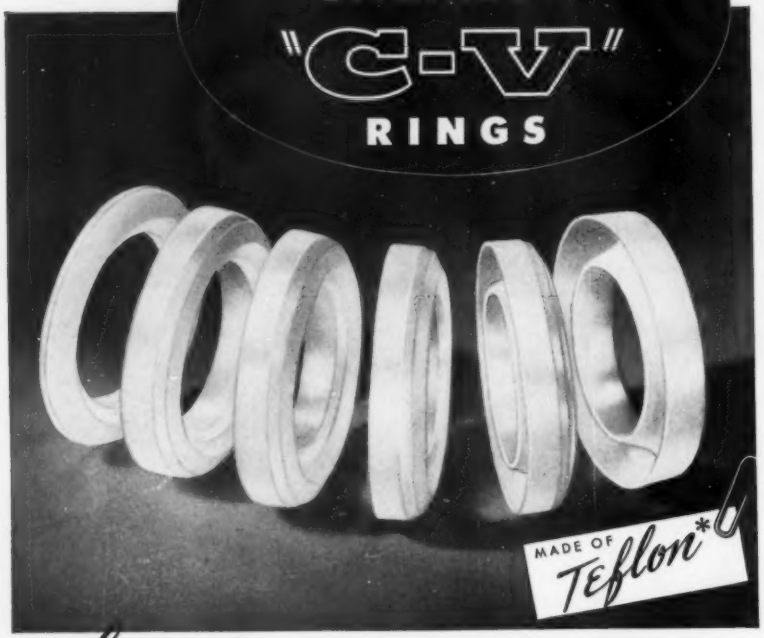
WITH JOHN CRANE
CHEMLON®
"C-V"
RINGS



for **CORROSION-FREE PACKING SERVICE IN PUMPS AND VALVES....**

You can effectively handle any corrosive liquid or gas by repacking your valves and pumps with "John Crane" Chemlon "C-V" Rings. Molded from the remarkable material, Teflon, "John Crane" Chemlon "C-V" Rings are impervious to almost every known chemical substance. They withstand extreme temperatures from −94° to +482°F—have extremely low friction coefficient. "Breakout" friction is only slightly higher than that of running friction. Special cross sectional design affords positive sealing at practically finger-tight gland pressure.

To bring you all the important advantages of Teflon for your particular sealing problem or application, "John Crane" has developed a complete line of Chemlon "C-V" Rings and male and female adapters. If you have special requirements, additional sizes can be molded to fit your stuffing box dimensions.

"John Crane's" illustrated booklet "The Best in Teflon" contains extensive information on a wide variety of Chemlon Products. Send for your free copy. Crane Packing Co., 1830 Cuyler Ave., Chicago 13, Ill.
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*DuPont's trademark

JOHN CRANE CRANE PACKING COMPANY

More PLANT PROBLEMS

Begins on page 130

POOR ENGINEERING causes *MV's* trouble. A purification system should have been installed when the plant was built because many headaches would be eliminated. If purification is too expensive, a large settling tank is the next best bet. Fit a filter between the tank and pumps to remove metal chips remaining in the oil.

Either batch or continuous filtration can be used, depending on plant needs. Oil contaminated with small particles requires more frequent cleaning than when the chips are large and can be easily settled out.

Clean oil gives better finishes and longer tool life—factors that help in writing off the extra cost of purification equipment. Remember that some cutting oils may cause dermatitis.

DONALD COCHRANE
Cambridge, Minn.

USE A CENTRIFUGE to remove the heavy metal particles and any acid that may be present in the oil stream. *MV* can expect the specific gravity of the oil to be about 0.82, that of the acid about 1.84. The chips, of course, would be extremely heavy in comparison with the fluids. If the mixture were left to settle for a time, it would stratify and clean oil could be drawn off the top.

While a series of magnets could be used to remove ferrous chips from the oil stream, a centrifuge is far better because it rids the coolant of any contaminants that are heavier than oil. Settling tanks are more or less ruled out because they would have to be extremely large to handle a 100-gpm flow.

ELBERT ROBBERSON
Port Washington, N. Y.

CUTTINGS in oil coolants can cause many pumping headaches unless they are removed from the stream. Using a large settling chamber ahead of the pumps effectively removes heavier particles. The chamber should be large enough to hold several hours' supply of oil and should have baffles to prevent short circuits. Remember, sufficient sludge capacity is also important; use a pump or other means to remove sludge.

Fit a centrifuge between the settling chamber and pump suction. It removes any solids or other contaminants that are not settled out. To prevent the oil becoming septic in summer, some means must be provided to cool it.

Consult a chemical engineer to determine the retention time needed to settle solids from the coolant. Knowing this and the flow rate, the settling-chamber size is readily figured.

IRA A BUTCHER *Cincinnati, Ohio*

(More answers to this question will appear next month.)

here's how high temperature piping can flex its muscles

Each pipe hanger is scale tested to rigid tolerances by a skilled workman at the Navco plant. After final assembly and inspection, the hangers are carefully crated and readied for shipment.

NAVCO *Counterpoise* Pipe Hangers

Since high temperature piping has no respect for equipment connections, the entire piping system must flex its muscles to absorb the strain of expansion and contraction. This prevents serious stresses that could endanger the installation.

And how does high temperature piping flex its muscles? With Navco's precision engineered Counterpoise Pipe Hanger—the hanger with a load-supporting effort that is of constant value throughout the range of travel. This permits weightless movement of the entire piping system.

To learn how power plants, oil refineries and chemical plants can have piping systems that flex their muscles, write today for Navco's 12-page Counterpoise hanger bulletin #153.

NAVCO

NATIONAL VALVE & MANUFACTURING COMPANY

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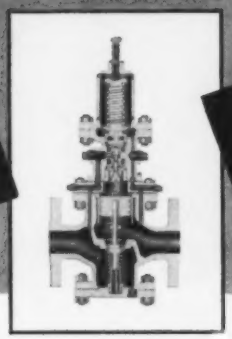
For Regulation of Steam Pressures up to 1500 P.S.I.

The FOSTER 50-G2



Approaches Instrument Control

The Foster 50-G2 Pressure Reducing Regulator accurately holds reduced pressure at a steady level — from maximum capacity to tight shut-off — regardless of normal variations in initial pressure. Extremely sensitive throttling action means that there is never more than a small, momentary deviation from the set point. It is furnished arranged for self-contained operation or remote control, depending on pressure requirements.

Foster 50-G2 Valves need less maintenance because the materials used in their construction are resistant to erosion and corrosion of severe service conditions and they are further protected by internal strainers. When servicing is necessary, it can be done without breaking the line, and it is made easier by interchangeable parts and assemblies.

High inlet-to-outlet ratio often eliminates a secondary stage valve in supplying low pressure steam for such uses as deaerating water heaters, tank storage heaters and auxiliary exhaust systems.

Available for initial pressures 25-1500 P.S.I.; temperatures to 950° F.; reduced pressures from 15" Hg. to 600 P.S.I. Sizes ½" to 12". Write for Bulletin G-101.

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E

LOW TEMPERATURES

Continued from page 121

compression system. Let's compare hook-up drawings to list gains:

(1) Because Freon-13 gets down to minus 114 F at atmospheric pressure, the cascade system maintains positive pressure, even at the low-stage compressor suction. If piping springs a leak we lose some charge, but main body of refrigerant is not contaminated with outside air and moisture. (2) Lower overall compression ratio of cascade system allows us to do the job with only two compressor stages. This not only saves equipment, but also cuts power costs. In one typical case studied, the compound compression system required 130 hp. The cascade system did the same job with 55 hp—a saving of 58%. (3) Cascade system is really two separate closed systems. This eliminates the oil-level controls used with compound compression. (4) Cascade design doesn't need subcoolers or intercoolers. (5) Pressure drop accompanies refrigerant flow in either system. But because the Freon-22 compound system works under high vacuum (1.626 psia) at the low-stage compressor suction, relatively small pressure drops result in large temperature drops. This cuts down efficiency of the compound system.

Expansion tank in suction line of Freon-13 cascade unit serves several important functions. It provides sufficient refrigerant reserve when system is in standby condition so when refrigerant is liquefied in operation, the charge will still be enough to keep a full liquid line from condenser to expansion valve. Without the expansion tank we would have to charge the system to 520 psi (liquefying pressure at atmospheric temperature—about 80 F). Equipment to withstand this pressure is costly. It also keeps down head pressure by bleeding gas from the compressor discharge during the temperature-pulldown or starting period.

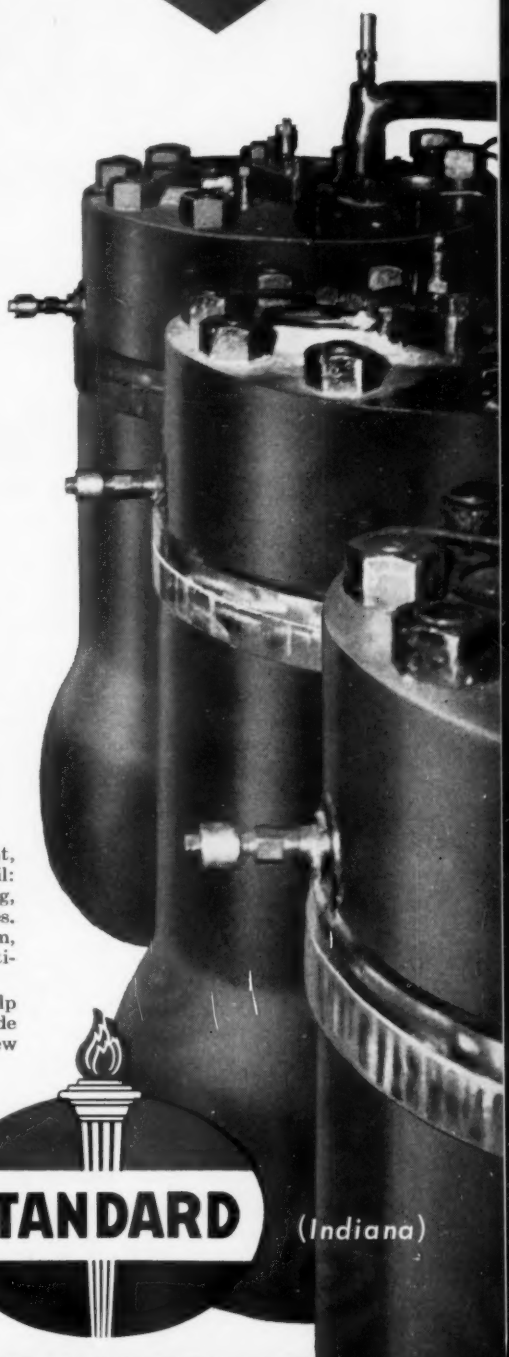
Desuperheater at F-13 compressor discharge removes superheat from refrigerant. This makes the oil separator's job easy. Cooler refrigerant can't hold as much entrained oil, especially at the low velocities in the separator. Job of the cascade condenser is also reduced.

We've attempted here to do nothing more than spell out some of the highlights of a relatively young field—ultra-low temperature refrigeration. If we allow our imaginations to wander we can picture the next step, triple cascade units with an even lower-temperature Freon refrigerant. Such a unit is actually in the lab stage. It reaches close to minus 200 F *without* vacuum at the low-stage compressor suction. If you've got the application for it, the *deep-freeze* specialists are at your service.

STANDARD HD
TRADE MARK
OIL

keeps rings FREE
(and cuts down wear!)

Bancroft Superintendent, Verne, Austin (left) consults with Standard Oil lubrication specialist R. R. Spargo, (right) on periodic check-up to see that STANDARD HD is still in like-new condition.



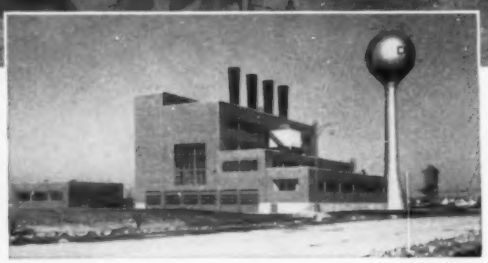
Here's what Verne Austin, superintendent of the Municipal Light Plant, Bancroft, Iowa, writes about the effectiveness of STANDARD HD Oil: "Before switching to STANDARD HD Oil, we were troubled with ring-sticking, dirty crankcases, excessive port carbon, frequent cleaning and stack fires. Since switching to STANDARD HD Oil, ring sticking is at an absolute minimum, crankcases are *always* clean, port carbon is almost nil, stack fires are practically eliminated!"

Since this plant switched to STANDARD HD Oil, they have also had the help and advice of an experienced Standard Oil lubrication specialist. He has made regular, periodic calls to check the oil and to make sure it's still in like-new condition.

STANDARD HD Oil lubricates better because it cuts down wear . . . keeps vital parts clean. If you have any lubricating problems, call your nearby Standard Oil office. Or write to Standard Oil Company, 910 S. Michigan, Chicago.

STANDARD OIL COMPANY

STANDARD (Indiana)



Above are two Goulds booster pumps for water supply at the Chrysler engine plant at Trenton, Mich. At right, the plant's powerhouse and water tank.

How Chrysler *Insures* *Water Pressure for Engine Plant*

The Chrysler engine plant at Trenton, Mich., uses more than 750,000 gallons of water every day, supplied from the city system at 40 p.s.i.g.

But to insure adequate pressure throughout the plant at all times, and to provide an emergency supply for fire protection, there is a 145-foot-high 200,000-gallon tank at the plant's powerhouse.

Two Goulds pumps maintain the water in that tank at the 140-foot level. An automatic control alternates the pumps in service, or can bring both into operation at once if one alone can not meet the demand.

These two pumps are 6″ bronze-fitted Fig. 3460 centrifugals, rated at 1080 GPM each.

Two smaller Goulds pumps of the same model circulate water from air compressor jackets to a cooling tower in the plant's powerhouse.

There are Goulds pumps for virtually every industrial pumping need. And Goulds engineers can help you select the right pump for your liquid-handling requirements. If you have any pumping problems, we'll be glad to consult with you about them. Your inquiry will receive prompt attention. Just write to Goulds Pumps, Inc., Seneca Falls, N. Y.

MEMBER

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PITTSBURGH • TULSA

MARMADUKE

Continued from page 142

butler, a Chinese cook, saddle horses and everything fit for two topnotch marine engineers like Bedlam and me. To top it all, our chits were good at the country club down the road, the firm paying all expenses.

"That afternoon we navigated our horses for the club so we could do a little ballasting and get our bearings. But we had hardly stepped inside when the lights conked out. Pedro the barkeep told us we'd have to get used to that because power failures were as common as drunken sailors since the local gang took over. That information gave me ideas.

"By next morning I had my course charted. Instead of sailing into the wind by getting tough with those Commies, I would sail with the wind by offering to straighten out the plant. But I couldn't wake Bedlam, even after dropping him on his head a few times. So I shoved off alone, steering for the village.

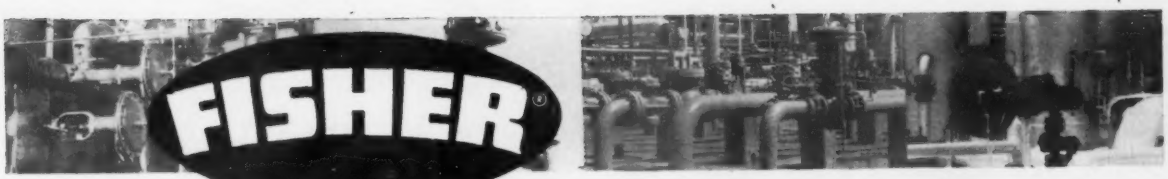
"The power plant was on the bay, with the main gate near the market place. And the gate was open, so I barged in. But that's as far as I got. An overgrown native popped up from nowhere and shoved a bayonet against my belly. He was fierce looking and had shoulders like a gorilla. I looked him straight in the eye and flashed my papers, which were written in Spanish.

"'My dear Amigo,' I said in my best Spanish, showing my teeth. 'I come from the Yankee land. I take charge of this planta electrica pronto. Savvy?'

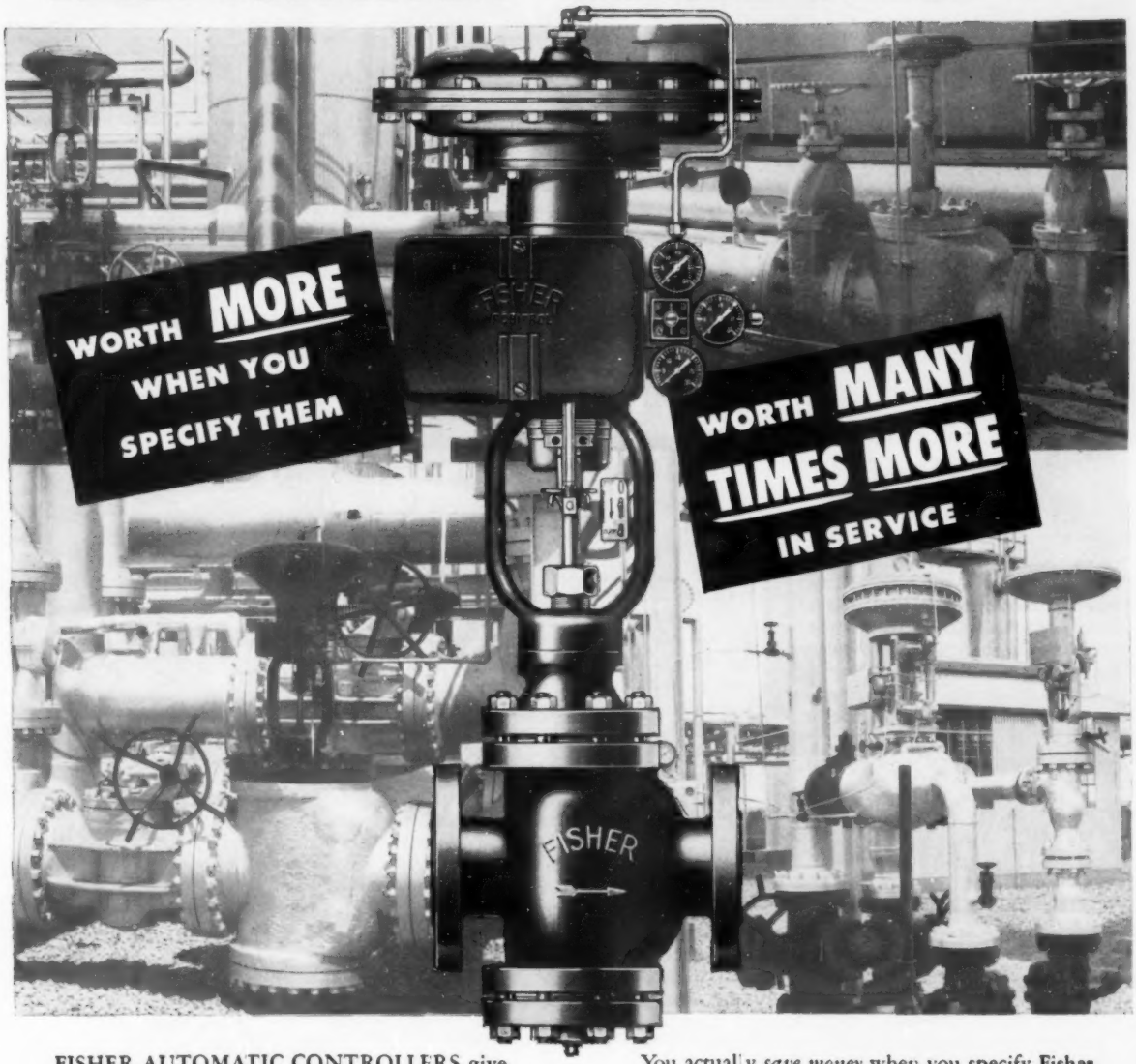
"'No entre, senor,' he roared, getting a firm grip on his cannon and yelling for help. That brought the head Commie on the double—with reinforcements. His boys were as loaded down with artillery as Captain Kidd's pirates. They had knives, swords, pistols and a few lengths of gas pipe for good measure. For a second I wished I was back at the Hacienda with Bedlam, but I thought of that remaining $23,000. Then I remembered Bunker Hill; I looked at the whites of that Commie's eyes, and saw his eyes weren't red but yellow.

"'Amigos,' I roared, load enough for Governor Ramon Juigalpa to hear me at his mansion, waving my credentials in his face. 'I am grande mecanico Yankee. You have mucha trouble with planta electrica because you no savvy this racket. I fix this planta pronto, then you make mucho electrica and mucho money. I take charge and I run this planta so everybody muy contento. OK?'

"My Spanish must have been shipshape because the head Commie seemed to savvy. He had a quick huddle with his gang. I stood there calmly puffing away on one of the old super's Havana Coronas. Finally, after a lot of jabbering, the



Automatic Controllers



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ELECTRIC HEATING AT ITS BEST!

MARMADUKE

Continued from page 214

boss came up for air and poked his hand at me in friendship, grinning from port to starboard.

"'Amigo Americano,' he drooled, 'We need mecanico—one turbine she not work, yes? You can fix, no? Boilers she not so good, too, see?'

"'No, I can fix, yes,' I said quickly, and with that I barged right through that young army and hurried into the plant before they came to. That fast maneuver threw them off guard and instead of haggling for terms they followed me like a bunch of hungry sharks. Inside, I made a quick inspection with the gang trailing in my wake.

"After I saw how they had run that plant onto the rocks in a few short months, I wondered how any electricity was generated. But at that it wasn't worse than a lot of American plants I had seen. I mean in states with no standards or engineers' licenses, where the first guy off the street is hired as chief—if he'll work for peanuts.

"Next day Bedlam and I turned to. We found one large Stirling boiler badly scaled. A quick check showed she had many blistered generating tubes.

"I learned that when a bearing burned out on a large circulating pump, the unit wasn't shut down in time and the condenser got overheated. She leaked and the boilers had salted badly from the harbor water.

"A 75,000-kw steam-turbine generating set was also in sad shape. I could tell they had tried to start her without backing out the starting screw. These were just some of the bigger headaches we found at a quick glance.

"Through scuttlebutt I learned that the head Commie had picked up the only engineering he knew as a fireman on a Panamanian freighter. A native told me that since the gang took over, some of the old, reliable plant operators felt they were better qualified than he and wanted to be boss. Not getting their way, they got careless. Most everyone wanted to give orders—no one to take them. And, as always, when the chief is only good at popping off his safeties, the place was being slowly scuttled.

"Bedlam and I got busy. The Commies kept their eyes on us. After a few days they got wise that we knew our stuff and that we wouldn't take any bilgewater, so they manned the oars. I ran a tight ship and made every native pull his own weight. And, true to human nature the world over, when the skipper is on his toes, his crew take pride in their work and pull together. Three months later that plant was in good enough shape to run without power failures, but there still was

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LEAK DETECTOR

This foolproof leak-detecting device is guaranteed to locate most of your leaks very quickly. To locate leaks, you merely pipe up the plant, then check each joint for a tight seal. Most leaks will show up on this device at start-up time. Those that are not found at start-up will usually be found as soon as the plant is in operation; vibration will make it easier for you to find the leaks.

This seems like an expensive way to find leaks when you consider that the leaks could be prevented by specifying Swagelok Tube Fittings.

Leaks are expensive. Stop them before they happen. Specify Swagelok. For catalog write Department 91.

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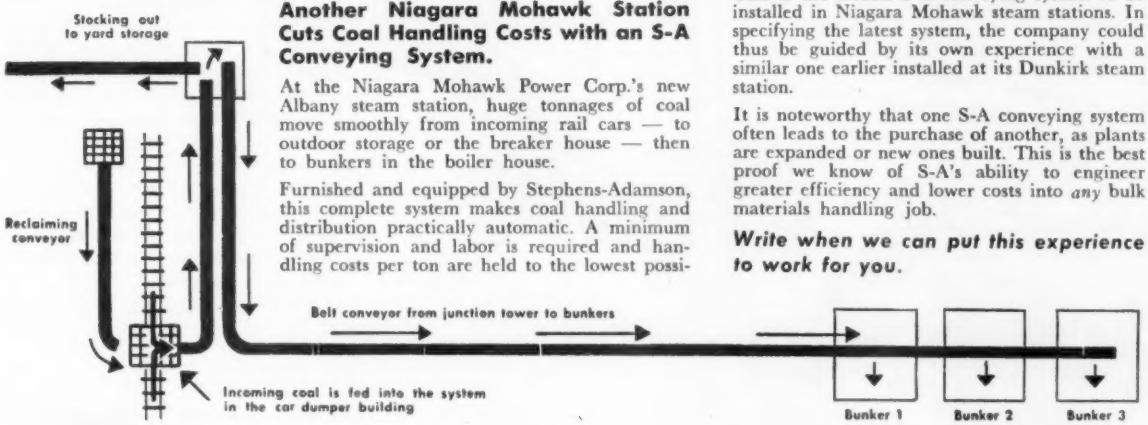
New Albany steam station of Niagara Mohawk Power Corp.

Coal "Highway" for a Steam Plant


Stocking out to yard storage
Reclaiming conveyor
Belt conveyor from junction tower to bunkers
Incoming coal is fed into the system in the car dumper building
Bunker 1
Bunker 2
Bunker 3

Another Niagara Mohawk Station Cuts Coal Handling Costs with an S-A Conveying System.

At the Niagara Mohawk Power Corp.'s new Albany steam station, huge tonnages of coal move smoothly from incoming rail cars — to outdoor storage or the breaker house — then to bunkers in the boiler house.

Furnished and equipped by Stephens-Adamson, this complete system makes coal handling and distribution practically automatic. A minimum of supervision and labor is required and handling costs per ton are held to the lowest possible level. Virtual elimination of coal dust and dirt also reduces plant housekeeping time and expense.

This is the second S-A conveying system to be installed in Niagara Mohawk steam stations. In specifying the latest system, the company could thus be guided by its own experience with a similar one earlier installed at its Dunkirk steam station.

It is noteworthy that one S-A conveying system often leads to the purchase of another, as plants are expanded or new ones built. This is the best proof we know of S-A's ability to engineer greater efficiency and lower costs into *any* bulk materials handling job.

Write when we can put this experience to work for you.

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A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

Sealmaster Division
A complete line of industrial ball bearing units available in both standard and special housings.

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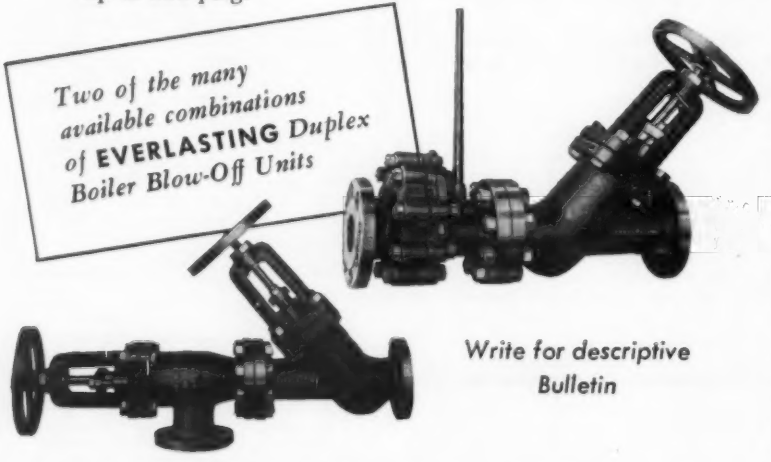
Standard Quick-Operating Everlasting Valve

Everlasting Y Valve

Everlasting Angle Valve

These Everlasting Valves are assuring safety in boiler plants all over the country. Each type is stoutly built, with ample strength, resistance to wear, and lasting tightness. Angle and Y designs have interchangeable parts for each size. The three types can be arranged in any combination as Duplex Boiler Blow-Off Units. All Everlasting Boiler Blow-Off Valves conform with ASME Codes, and are available in a range of sizes for pressures up to 600 psig.

Two of the many available combinations of **EVERLASTING** *Duplex Boiler Blow-Off Units*



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EVERLASTING VALVE CO., 45 Fisk Street, Jersey City 5, N. J.

Everlasting Valves

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EV382

for everlasting protection

MARMADUKE

Continued from page 216

plenty to do.

"That time played into our hands in more ways than one. Our ambassador, Dwight Carter, arrived in Costa Blanco to talk sense to President Coban Flores.

"Finally Flores saw the light and had Juigalpa call another 'election' in Porto Bello. But this time the Commies 'lost.' That put the power plant back into the owners' hands. I was in full charge then until the new super came down from the States.

"Before the election the Commie treasurer and I got friendly. He was happy because the plant was paying off again. I finally sold him on how unhealthy that state would be if his gang lost power. He was a Spaniard and played it safe by beating it back to the old country. But being a practical guy, he took 400,000 pesos of the sindicato's money with him. I understand he settled down on easy street, in old Madrid.

"After the new American super showed up, Bedlam and I shipped out on a French tanker for Barranquilla, Columbia. There we ran into another soft job. This time we saved a coffee plantation from having to buy a new narrow-gage locomotive because we rebuilt the old one. We also had a lot of fun and added to our bankroll by debunking a native superstition. And all we did was to clean a bird's nest out of a factory whistle.

"But after a few months we not only cashed in on our engineering knowhow but also soaked up a lot of loose germs in that tropical paradise. So we headed back for New Orleans. Soon as we collected in full for that Costa Blanco job, Bedlam and I set our course for Hot Springs. There we boiled the bugs out of our system for a few weeks. Then we got wanderlust and craved some excitement. This time we sailed an old steel-hulled derelict that had been salvaged and loaded with 6000 tons of scrap iron for Japan. There, the ship and her machinery were junked. How we got her across the Pacific during the hurricane season, with the boiler room shipping water and the bilge pumps broken down is another story." —S. M. E.

ARGUMENTS

Continued from page 136

of both covering materials and wiring. I believe xylene would have the same drying characteristics.

3. When exposed to atmosphere it emits a gas known as phosgene. This gas causes severe respiratory irritation and has been known to be fatal, especially in a poorly ventilated room.

4. If carbon tetrachloride comes in contact with an open bruise or cut, or

For any splicing or insulating job—
there's a "U. S." Tape

U.S. HOLDTITE FRICTION TAPE
3/4" • 82½ FT.
NO. 8 ROLL
non•RAVELLING
MADE TO A.S.T.M. FEDERAL AND PUBLIC UTILITY SPECIFICATIONS
U.S. HOLDTITE FRICTION TAPE
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HOLDTITE® FRICTION TAPE

This is the strong, tacky tape that really grips and stays on. The fabric has unusually high tensile strength to handle *any* electrical or general purpose job. Non-ravelling, straight-tearing. No pinholes to cause leaks. U. S. Holdtite exceeds A.S.T.M. Specifications.

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For durable splices on all general electrical work. Holdtite is an unvulcanized rubber splicing compound with high tensile strength, high elongation and tackiness plus dielectric strength. Electricians like its "feel". Easy to handle, pulls down tight and *fuses* quickly into a solid mass without heat or undue pressure. Insures long-aging splices. U. S. Holdtite exceeds A.S.T.M. Specifications.

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For making a thin splice and keeping wiring neat and uncluttered, many maintenance men find Royalastic is best. It does the work of both rubber and friction tape in many uses. Complete mechanical and electrical protection. High tensile strength and excellent resistance to abrasion and to water, oils, acids, alkalies and corrosive chemicals. Good stretch, pulls down tight, stays on. Approved by Underwriters' Laboratories, Inc.

When you need industrial tape, simplify your purchasing by ordering from a single source—one of our numerous distributors or direct from one of our 25 District Sales Offices. Put your order in now.

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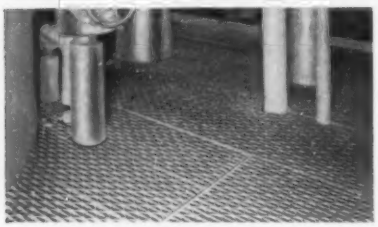

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ESTABLISHED 1902

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1888 10th St., Oakland 20, California

ARGUMENTS

Continued from page 218

even with some of the more tender parts of the body such as eyes, nostrils, etc, it can become very harassing and may contribute to blood poisoning.

IRVIN ROSER *Milwaukee, Wis.*

Use gasoline or kerosene to clean ball bearings

NELSON FULLER SAYS, in May *Arguments*, he has been advised that carbon tetrachloride and xylene attack bearings.

I suggest that he use gasoline or water-free kerosene to clean precision-type bearings. If the bearings are very dirty or are filled with hardened grease, soak in cleaning fluid for a long time to loosen dried or caked matter.

Other suitable solvents are benzine, turpentine or trichloroethylene. You can lessen the fire hazard of benzine by adding an equal amount of alcohol, making the solution practically equivalent to gasoline as a solvent.

When using turpentine, take care to prevent it from evaporating in the bearing internals, as a tar-like residue results. After cleaning, remove all traces of turpentine with compressed air, or by spraying bearing with oil.

As another alternative, use a 2-5% soda or soap solution. Then spray with boiling water having an addition of 0.1% sodium nitrite. Do not leave rinsing liquid in the bearing, but remove it with filtered compressed air.

A solution of 0.1% sodium nitrite and water will not rust steel, but will attack cast iron. To avoid cast-iron corrosion, use a 3% sodium nitrite solution. When cleaning both bearing and housing with a soap solution, use the stronger nitrite solution for the second washing. After cleaning, oil bearings immediately.

H B WAYNE *Brooklyn, N. Y.*

WITH OUR READERS

Continued from page 5

gigantic irrigation, power and flood-control project. Transmission lines carry Bokaro power to Calcutta, nearly 200 miles away. The main plant has three 60,000-kw units, room for another when needed. Cooling water comes from Konar Dam, part of the project; an aerial conveyor supplies coal from nearby Bermo strip-mine fields.

The "turnkey" contract awarded to Kuljian Corp included training Indian engineers now in full charge of operations.

STANDARDIZE ON MICRO-RINGELMANN . . .

Congratulations to POWER on the Micro-Ringelmann chart. I'm not a smoke inspector but I am an engineer serving coal-producing firms.

Some are afraid of the Ringelmann because of its effectiveness. We feel that where we have been eliminated as a supplier of

"LUBRIPLATE, THE OUNCE OF PREVENTION"

says
VULCAN IRON WORKS, INC.
of Chicago, Ill.

—a leading manufacturer of pile driving and extracting equipment

"For many years we have used LUBRIPLATE Lubricants for shop assembly, and have recommended them to our customers through your LUBRIPLATE Tag Plan. Our experience shows that if the proper lubricants are used from the beginning, there are fewer problems and parts replacements later. We consider LUBRIPLATE to be the best possible ounce of prevention."—
H. G. Warrington, Vice-Pres.

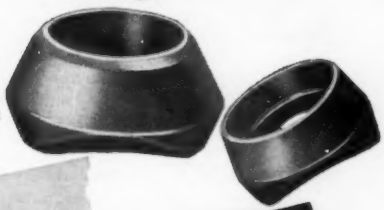
REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

LUBRIPLATE is available in grease and fluid densities for every purpose... LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

FROM THE HORN OF PLENTY AT BONNEY FORGE

WELDOLETS and THREDOLETS for Stainless and Alloy Piping



STAINLESS
F 304 304 ELC F 316 F 347

CHROME MOLY
A 182 F 12 F 11 F 22 F 5

MONEL

WROUGHT IRON

ALUMINUM

AND OTHER ALLOYS

When constructing with alloy, you're investing *real money*. Assure performance-proved fittings and save dollars by specifying and using Weldolets and Thredolets for 90° branch joints—large and small, full size and reducing.

Distributors in Principal Cities

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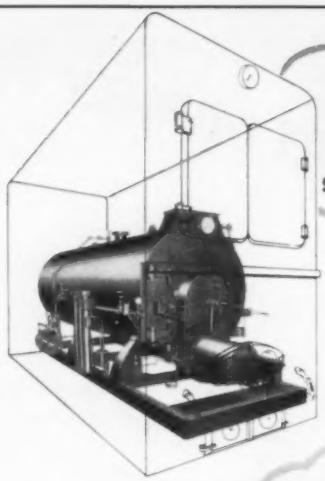
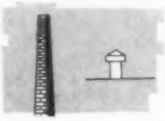


It's not the **SIZE** that counts in steam generation

It's the **SAVVY**



No Huge, Costly Stack. Only Simple Flue or Vent Required.

Factory-Tested Cyclotherm is shipped complete . . . with refractory, burner, control panel, etc. No other contractors needed.

Cyclotherm engineers will estimate your requirements. Servicemen immediately available at any hour.

Cyclotherm units range from 18 to 500 hp. . . . from 15 to 200 psi.

The heat transfer rate of Cyclotherm's exclusive, patented Cyclonic Combustion is unequalled by any other method of combustion. Only 3 sq. ft. of heating area per boiler horsepower is needed . . . a bonus to you of 66% more steam generating power per sq. ft.!

Cyclotherm requires only two passes to reach a minimum heat transfer rate of 80%. Maintenance costs are reduced as much as 50%. The single pass of return tubes is easily accessible for cleaning . . . the combustion chamber needs no cleaning. The burner nozzle can be replaced in five minutes by any maintenance man.

Cyclotherm reaches its peak capacity faster . . . from cold start to full power in 15-20 minutes . . . and holds it steadily under extreme load conditions.

The flame is always perfectly controlled. Distribution is even throughout the furnace length . . . never impinging on the wall to cause hot spots and localized heat-retarding scale.

Cyclotherm is up to ⅓ smaller than any other packaged unit . . . 60% smaller in floor area than conventional boilers. Yet it delivers the same capacity . . . faster and more economically.

YEARS AHEAD IN STEAM GENERATION

CYCLOTHERM

STEAM AND HOT WATER GENERATORS

Cyclotherm Division
U. S. Radiator Corp.
Oswego, New York

RETURN THIS COUPON TODAY

CYCLOTHERM DIVISION
U. S. RADIATOR CORP.
Dept. 224, Oswego, New York

..... Make a steam survey of my plant . . . without cost or obligation . . . and show me how I can get 66% more steam for my fuel dollar.

..... I am not ready for a survey, but please send me your illustrated folder explaining Cyclotherm's many advantages.

Name .....
Company .....
Address .....
City ..... Zone .. State .....

WITH OUR READERS

Continued from page 220

fuel because of high volatile content, proper firing methods would have kept stack emission within limits of the Ringelmann chart. No plant getting proper stack CO_2 would be a violator of smoke ordinances. Visible smoke is an indication of a weak link, careless or overloaded plant operation.

Standardize on the Micro-Ringelmann and the smoke problem will be well on the way to defeat. Then some good fuels thrown out of business will regain some lost markets. These were lost because plant equipment couldn't burn the fuels properly to prevent smoke—not because of the fuel. And many of these plants are still emitting violations of smoke ordinances.

Cumberland, Ky. CHARLES O'ROARK

Most comments on POWER'S *Micro-Ringelmann are, like this one, favorable to the idea. How about some criticisms from the skeptics? If the scheme has any "bugs" we want to know about them.*—ED.

Coming Events

Sept 15-21—Instrument Society of America, First International Exposition and Congress, Commercial Museum, Philadelphia, Pa. Information from Richard Bimbach, managing director, 845 Ridge Ave, Pittsburgh 12, Pa.

Sept 27-29—American Institute of Electrical Engineers, petroleum conference, Mayo Hotel, Tulsa, Okla. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Sept 28-Oct 1—1954 Iron and Steel Exposition and annual convention of the Association of Iron and Steel Engineers, Cleveland Public Auditorium, Cleveland, Ohio. For details write AISE, 1010 Empire Bldg, Pittsburgh 22, Pa.

Oct 11-15—American Institute of Electrical Engineers, Fall General Meeting, Morrison Hotel, Chicago, Ill. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Oct 13-16—National Industrial Conference Board's Third Annual Conference on Atomic Energy in Industry, Hotel Commodore, New York. Information from the National Industrial Conference Board, 247 Park Ave, New York 17, N. Y.

Oct 18-20—Engineers Society of Western Pennsylvania, Fifteenth Annual Water Conference, Hotel Wm Penn, Pittsburgh, Pa. Information from ESWP, Hotel Wm Penn, Pittsburgh 30, Pa.

Oct 22-23—Institute of Power Engineers, annual convention, Windsor, Ontario. Details from W G Child, IPE, 410 Bloor St East, Toronto 5, Ontario.

Dec 2-7—21st National Exposition of Power and Mechanical Engineering, Commercial Museum, Philadelphia, Pa. For information, write International Exposition Co, 480 Lexington Ave, New York 17, N. Y.

MONOPLAST . . . *a new, one-coat insulation finish for cold room walls and ceilings*

Monoplast is an entirely new, light-reflective white finish for cold rooms. Trowelled on in just one coat, it dries to a durable surface for all temperatures to 80° F. below zero. Monoplast reflects 72% of the light that strikes its surface, resulting in an exceptionally bright cold room interior. Its resilience and strength protect the insulation from abrasion. Monoplast is easy to maintain.

A Monoplast finish is completely monolithic, with no score marks to mar its surface. It needs no painting and can be washed with water and commonly used cleaning agents. It weighs only about one-fifth as much as two-coat portland cement plaster and can be applied to ceilings as easily as to walls.

This new finish is available through Armstrong's Contract Service. It is one of the new products of Armstrong's research that are simplifying application methods in the industrial insulation field.

For full details on Monoplast and Armstrong's Insulation Contract Service, call the Armstrong office nearest you or write today to Armstrong Cork Company, 203 Stratton Street, Lancaster, Pennsylvania.

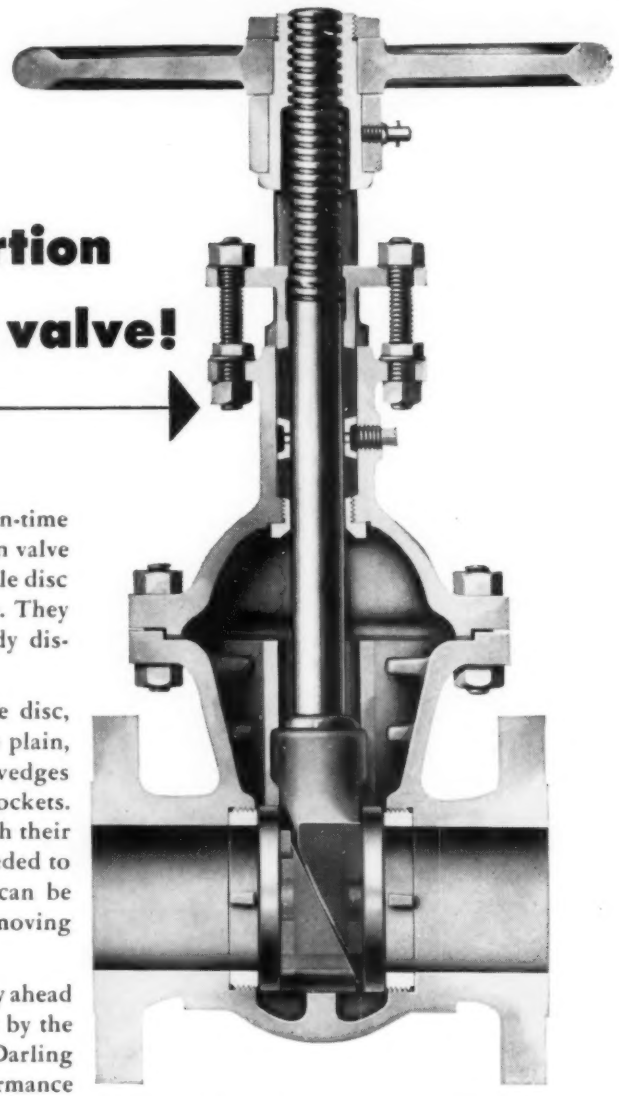
Applied by trowelling, one coat of Monoplast provides a tough, durable cold room finish that will last for many years. Armstrong's Monoplast eliminates the necessity of scoring and painting the walls.

ARMSTRONG'S INDUSTRIAL INSULATIONS

DARLING VALVES

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

Valve body distortion no problem for this valve!



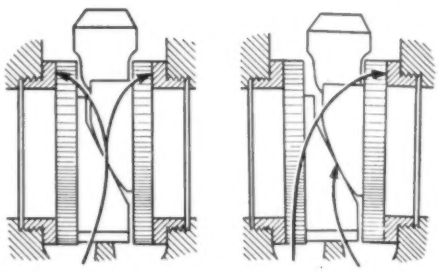
DON'T let costly valve maintenance and down-time headaches get you down! Lick these common valve troubles by installing Darling fully revolving double disc gate valves, with their unique wedging principle. They adjust *automatically* to compensate for valve body distortion—cinching tight, leak-proof closure.

The difference is in the fully revolving double disc, parallel seat principle of Darling valves. Just two plain, interchangeable no-pocket discs and two rugged wedges do all the work. Discs are completely free of pockets. Sediment and scale cannot collect to interfere with their free movement. No links or other devices are needed to hold the discs and wedges together. Any part can be quickly and inexpensively replaced without removing valve from the line.

It's easy to see why Darling valve users are money ahead because of the exceptional service made possible by the Darling design. That's why in plant after plant Darling gate valves are giving longer, trouble-free performance with minimum attention.

Darling features add up to gate valve service at its low-cost best! Send for the free Darling Valve Bulletin, today.

NOTE: Darling gate valves are made in a wide range of sizes, types and constructions, including solid and slotted taper-seat wedge types for all kinds of normal and corrosive services in pressures up to 1500 pounds.



Discs and seats are parallel. *Seats are forced out of parallel by body distortion but discs adapt themselves to give positive closure.* *Radiused face of wedge allows discs to adjust tightly against both seats.*

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd. Galt 19, Ontario

"We had a picnic on the boiler room floor"

"When the Chief Engineer recommmended coal-burning boilers for the new plant, one of the directors asked if coal wouldn't make the plant dirty.

"That made the Chief mad! He didn't say anything at the time, but at the first board meeting after the new plant was finished he invited the directors down for lunch.

"You should have seen their eyes! The place was hospital clean. And why not? The coal came into the stoker through dust-tight chutes, and the ashes were piped out through pneumatic tubes.

"While the directors were eating, the Chief gave them a chalk-talk. On one side of the blackboard he had charted the savings through the use of of coal as compared with other fuels. On the other side he had a comparison of our proven reserves of the various fuels showing that while other fuels are growing scarcer, we have barely scratched the surface of our almost inexhaustible coal deposits."

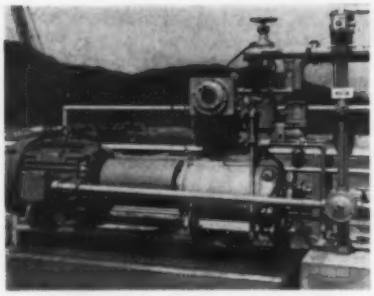
COAL
FUEL OF THE FUTURE

Chesapeake and Ohio Railway

Bring your fuel problems to C&O

As the world's largest carrier of bituminous coal, the C&O is intimately familiar with every phase of coal use. We have a large staff of experts who will gladly help you to locate the coal best suited to your needs; to help you use it most efficiently; to help get it to you promptly.

Write to:
Coal Traffic Department
Chesapeake and Ohio Railway
2115 Terminal Tower
Cleveland 1, Ohio



Pumping Propane With a FRICK "ECLIPSE" Compressor

The Tennessee Eastman Company, at Kingsport, uses this 3-cylinder Frick compressor in transferring propane from tank cars to the storage tanks shown in the background. Explosion - proof controls were furnished for this exacting service.

Many Frick compressors are used for transferring ammonia, also for handling carbon dioxide, ethylene, and other gases.

Whether you need equipment for processing, air conditioning, ice making, quick freezing, or other cooling work, there's a Frick refrigerating system to meet your requirements. Let us submit estimates.

FRICK CO.
WAYNESBORO, PENNA. U.S.A.

Below: Frick compressor transferring ammonia at the Frisco (Texas) Fertilizer Co.

More FREE BULLETINS

Begins on page 163

ELECTRICAL EQUIPMENT

16 voltage adapter are illustrated in **Electrostatic voltmeter** and peak 8-page bulletin No. 9. Includes photos, installation diagrams. Sensitive Research Instrument Corp, 9-11 Elm Ave, Mt Vernon, N. Y.

17 **Motor starters,** 16-page booklet 1062 illustrates starters using 50,000 kva interrupting capacity contactor. Starters have short-circuit protection for 2200-5000 v systems. The Electric Controller & Mfg Co, 2700 E 79th St, Cleveland 4, Ohio.

18 **Mercury relays** are itemized in 4-page two-color catalog 154. Fast-acting plunger relays handle current loads up to 60 amperes and motor loads up to 3 hp, according to the manufacturers. Ebert Electronics Corp, 212-26 Jamaica Ave, Queens Village 28, N. Y.

19 **Battery and test clips,** insulators for clips and similar products are described in 8-page catalog No. 150. Television and radio clips and testing equipment is included. Photos, specs and descriptions. Mueller Electric Co, 1583 E 31st St, Cleveland 14, Ohio.

20 **Television camera system** for industrial use is described in 4-page brochure. Includes principle of operation, specifications and photos. Kalbfell Laboratories, Inc, 1090 Morena Blvd, San Diego 10, Calif.

21 **Electrical conductors,** research and progress report on aluminum. 16-page, two-color, illustrated booklet, "Alcoa Research and Progress in Electrical Conductors." Aluminum Company of America, 725 Alcoa Building, Pittsburgh 19, Pa.

22 **Distribution transformers** for banked secondary systems are described in four-page illustrated bulletin 61B8054. Says secondary banking improves service by connecting transformer capacity so temporary overloads are distributed among two-or-more transformers. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee 1, Wis.

23 **Instrument transformers** discussed in 30-page, two-color, illustrated bulletin 131-120. Includes facts on 15 types, drawings, specs, photos and tables. R E Uptegraff Mfg Co, Scottdale, Pa.

24 **Duplex function plotter** described in single-page data sheet 10.0-17. Discusses application and principle involved. Records two independent variables as a function of a third. Minneapolis-Honeywell Regulator Co, Industrial Div, station 64, Wayne & Windrim Aves, Philadelphia 44, Pa.

25 **Motor selector,** 12-page illustrated bulletin B-2102, describes motors from 1 to 200 hp and gives dimensions, prices and performance data. The Reliance Electric and Engineering Co, 1076 Ivanhoe Rd, Cleveland 10, Ohio.

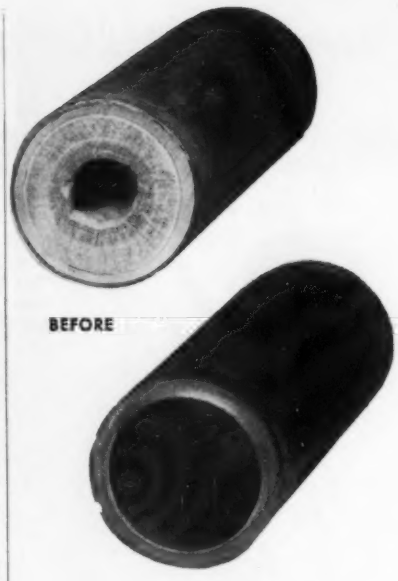
INSULATION

26 **Concrete pipe coating.** A chemically resistant preparation is discussed in 4-page bulletin R-2. Includes description of product, application instructions, specifications and tables. Hamilton Kent Mfg Co, Kent, Ohio.

27 **Insulated wire cables** described in 140-page, illustrated book for the electric utility industry. Chapters on insulation compounds, service cables, power and lighting cables and other equipment. United States Rubber Co, 1230 Ave of the Americas, N. Y. 20, N. Y.

28 **Surface coatings,** lagging adhesives, sealers and vapor barriers are listed and explained in 20-page reference manual No. 545. Includes technical product data, application specs and product development request form. Benjamin Foster Co, 4635 W Girard Ave, Philadelphia 31, Pa.

29 **Asbestos sheet.** Sizes, thicknesses and main features, discussed in 4-page illustrated folder. Ring-cutting machine also shown. The



AFTER descaling with Oakite Compound No. 32

DON'T ROD OUT SCALE

—Dissolve It!

OAKITE COMPOUND No. 32 did all the work on this pipe—did it better, faster, far more safely than any mechanical method.

Oakite Compound No. 32 *dissolves* scale and rust as it circulates—often makes dismantling of equipment unnecessary. Removes *all* deposits —flows into areas inaccessible to rod and drill. Does not affect sound metal surfaces—does not change dimensions of tubes and piping.

Use Oakite Compound No. 32 to descale and derust

condensers	heaters
compressors	brine coolers

FREE HANDBOOK 4305 tells all about it. Ask your local Oakite Technical Service Representative. Or write Oakite Products, Inc., 20A Rector St., New York 6, N. Y.

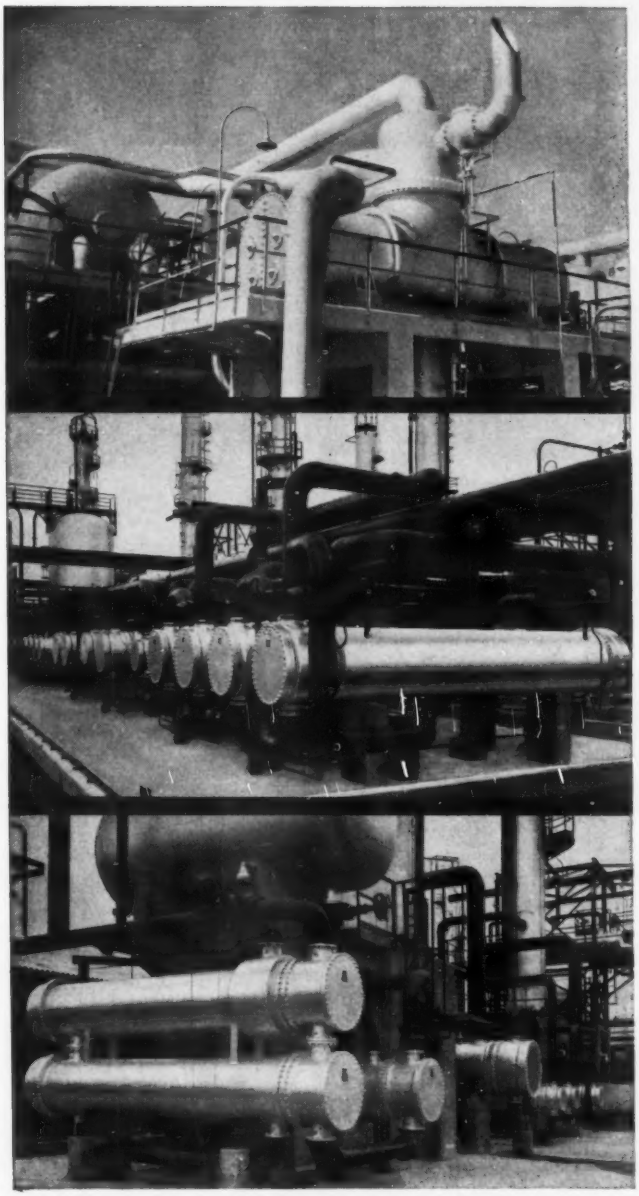
SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada

this...

ROSS

on your specially engineered exchanger means BONUS VALUES



Specially engineered exchangers designed and built by Kewanee-Ross embody features and services that have long been acclaimed throughout the refinery and petrochemical industries. "Bonus values" . . . they're called.

Characteristic Kewanee-Ross standardization is one of them. Substantial delivery time and savings in engineering costs can often be gained through the suitability of standard components for many specially engineered units.

A large stockpile of engineering experience is another. Kewanee-Ross engineers have had long experience with many special and unusual applications. Designing and production are off to a faster start.

Long a leader in the heat exchanger and surface condenser fields, Kewanee-Ross is today in the best position of its history to meet your requirements. Now, with the added capacity of a second large plant (Kewanee, Ill.), recently re-equipped with completely modern machinery and supervised by key "Ross trained personnel," Kewanee-Ross is ideally situated to supply all types of heat exchangers, built to any code, on a very favorable delivery schedule.

Arrange an immediate consultation with the Kewanee-Ross representative nearest you, at your earliest convenience. You have only your time to invest.

KEWANEE-ROSS CORPORATION

DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

1415 WEST AVENUE • BUFFALO 13, N. Y.

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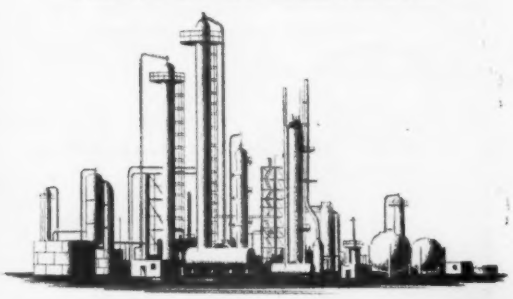
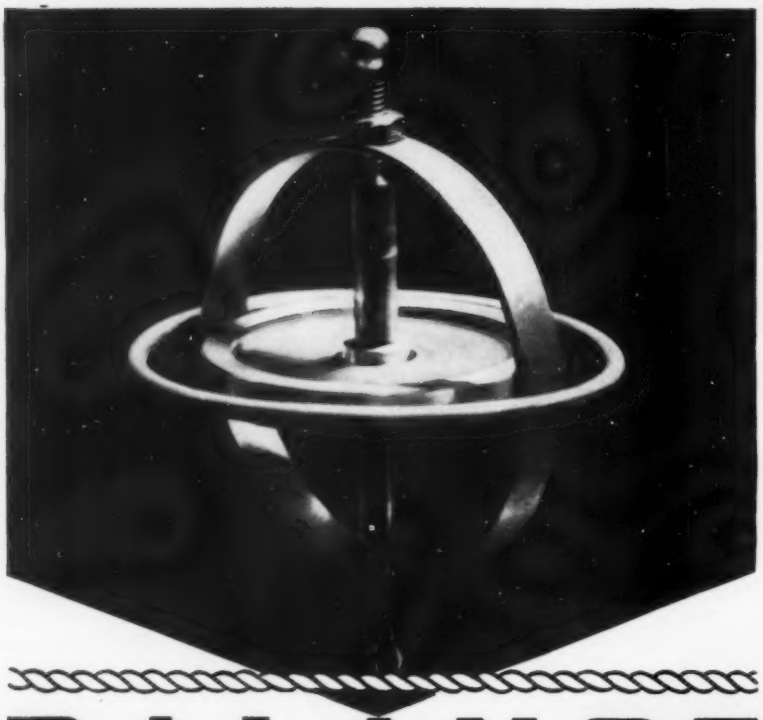


Serving home and industry: AMERICAN STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS



BALANCE

For *true worth* the cost of industrial insulating materials and installation should be balanced against the efficiency and life of the insulation.

First cost may be a deceptive indicator of insulation value. You may spend double the amount necessary and not get your required protection. On the other hand, the lowest bid can be the costliest.

Mundet has a closely integrated, experienced, nation-wide organization. Our engineers will survey your plant to see that the necessary lines and equipment are insulated with the *right material* and the *right thickness* to provide greatest economy and longest life.

The value of Mundet service can be easily demonstrated. The quality of Mundet insulating products is guaranteed. Mundet Products cover every temperature requirement from minus 200°F. to plus 1900°F. One of our newest products is WATER RESISTANT 85% magnesia designed to protect hot piping and equipment from water exposure damage. Send coupon for information on this and other Mundet products.

There's a Mundet Office near you

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7103 Tonnelle Ave., North Bergen, N. J.

Send information on Mundet Industrial Insulations.

NAME.....

FIRM.....

ADDRESS.....

More FREE BULLETINS

Begins on page 163

Klinger Corp of America, 95 River St, Hoboken, N. J.

30 **Insulating brick** in the 1600 to 3000 F classes is discussed in 12-page, full-color bulletin EB-D. 2-page thermal chart shows heat losses, heat storage capacities and cold face temperatures for brick insulated walls. Harbison - Walker Refractories Co, Farmers Bank Bldg, Pittsburgh 22, Pa.

MAINTENANCE AND SAFETY EQUIPMENT

31 **Safeguarding water-using equipment** during shutdowns is the subject of 6-page folder on methods of safe handling of boilers, turbines and other steam machinery when not in use. Hall Laboratories, Inc, Hagan Bldg, Pittsburgh 30, Pa.

32 **Airless blast machine** to clean castings, forgings, heat treated parts, die castings or stampings. Bulletin 114-B. Includes installations, electrical and mechanical specifications and case-histories. American Wheelabrator & Equipment Co, Mishawaka, Ind.

33 **Cleaning air conditioning** and refrigeration systems with chemical solvents discussed in 2-page bulletin. Case histories, use during peak and "off" seasons. Dowell, Inc, Tulsa 1, Okla.

34 **Sealing cracks and leaks** is the subject of 48-page "how to" handbook showing application of repair cements for leaks in pipes, boilers, radiators, concrete and cinder blocks, sheet and plate metal. Smooth-On Manufacturing Company, 570 Communipaw Avenue, Jersey City 4, N. J.

35 **Vibration mounts** that will withstand loads to 3800 lbs each are the subject of 8-page brochure. Includes installation directions and specs. Hamilton Kent Mfg Co, Kent, Ohio.

36 **Rupture discs** of precious metals, uses and application to industry. Eight-page, two-color illustrated brochure "Baker Rupture Discs" includes data and bursting pressures. Baker & Co, Inc, 113 Astor St, Newark 5, N. J.

37 **Fence Painter.** Roller method of applying paint to fences, walls and sidings. 32-page, illustrated brochure lists prices, uses and necessary equipment. Fence Painter Corp, 2314 W. Van Buren St, Chicago 12, Ill.

MAINTENANCE MATERIALS

38 **Mastic protective coating** for surfaces exposed to corrosive materials and subject to rusting is described in 4-page booklet. Palladium Mastic Corp of America, 327 Union Ave, Rutherford, N. J.

39 **Corrosion resistant coating** for lining tanks, for protection against spillage and for fume and outdoor protection, is described in 4-page bulletin 100. Describes use of several types of coatings and primers. Carboline Co Div, Mullins Non-Ferrous Castings Corporation, 331 Thornton Avenue, St Louis 19, Mo.

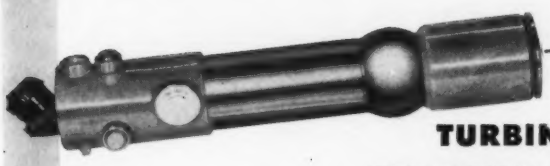
40 **Heat-resistant** silicone base aluminum paint is the subject of one-page bulletin L-9240. Illustrates use of *Heat Rem H-170*, said to be successful up to 1700 F. Speco, Inc, 7308 Associate Ave, Cleveland 9, Ohio.

41 **Repair clamps and saddles** for steel and cast iron pipe are discussed in 28-page catalog No. 54. Includes photos and applications. M B Skinner Co, South Bend, Ind.

MATERIALS HANDLING

42 **Sling,** equalizes unbalanced loads and permits their handling with minimum effort. Four-page, illustrated brochure. The Caldwell Co, 1830 Camp Ave, Rockford, Ill.

NEW OPTICAL METHOD



ALIGNS

TURBINE GENERATOR CYLINDERS
PEDESTALS • BLADE RINGS • DIAPHRAGMS
SOLE PLATES, ETC.

*** MORE ACCURATE**
SAVES MONEY
SAVES TIME

Alignment telescopes are now used by The CONSOLIDATED EDISON COMPANY OF NEW YORK and other electric utilities to align turbine generators:

*

"Alignment-telescope method is more accurate, less costly, takes less time... permits other work to go on in area, even installing or removing of internal turbine parts."

Ref:—POWER, Vol. 98, No. 5, May, 1954

NOW...

The optical method is used to establish a straight line of sight by means of an alignment telescope trained on targets which are positioned in the gland bores of the turbine. Pedestals, diaphragms and other parts can then be positioned relative to this line of sight simply by looking through the telescope.

This new method helps reduce "outage" time, is precise, fast and dependable.

The method is not complicated and regular plant personnel learn how to use it quickly and easily.

A conservative estimate of "outage" time savings by use of the optical method, compared with old mechanical technique is 50%. Cases on record show that setting diaphragms in a single cylinder machine took only 3 *hours* as compared with 2 weeks by the old method!

For additional information and data SEND FOR BULLETIN NO. 815

PRECISION OPTICS
ELECTRONIC AND SCIENTIFIC INSTRUMENTS

FARRAND
OPTICAL COMPANY, INC.

Engineers, Designers and Manufacturers

BRONX BOULEVARD AND EAST 238th STREET, NEW YORK 70, N.Y.

ONLY
TRI-LOK
OPEN STEEL FLOORING

Gives you all these Service Features!

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Can be fabricated from a variety of metals

FREE CATALOG

Write today for Bulletin QK-110 -46

Locked-in Strength
Cross bars are locked in place under 1600 tons pressure. This assures permanent rigidity and a flush top surface.

Clinch-Lock Cross Bars
Bent-over bars lock assemblies into permanent integrated panels.

Self Cleaning
Better than 80% open area assures self cleaning.

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CORPORATION
National Distributor for THE TRI-LOK COMPANY
Dravo Building • Fifth and Liberty Avenues
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SALES
in the power field

If you sell a power-field product, you may have profitable use for POWER's new 1954 "Directory of Manufacturers' Agents Serving the Power Field."

See page 260

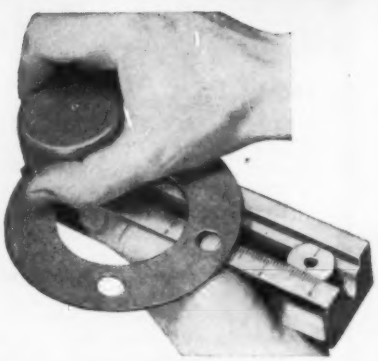
ALLPAX
GASKET CUTTERS

TOOLS THAT PAY FOR THEMSELVES THE FIRST TIME THEY'RE USED

Whatever gasket material you use (and we suggest "ALLPAX" for your protection and convenience), you can cut it with the ALLPAX GASKET CUTTER . . . a tool designed and made by packing specialists.

With this tool in your plant you have available a means of cutting gaskets up to ¾" thick, from ¼" to 48" diameter, as well as bolt holes.

Here's a handy tool to save you time and to enable you to meet any emergency . . . a tool that will pay for itself the first time it's used. Ask for complete details.



Be sure and contact ALLPAX or any of its distributors for packings for all services: specials to order, valve discs, retainer rings, molded or mandrel cut packing rings and packing hooks.

THE ALLPAX COMPANY INC.
805 Mamaroneck Ave., Mamaroneck, N.Y.

Superheat Sheet Packing . . . Oil Proof Sheet Packing . . . Red Rubber Sheet Packing . . . Diaphragm Sheet Packing . . . Cloth Inserted Sheet Packing

More TECHNICAL BRIEFS

Begins on page 150

This requires interconnecting the principal power buses in the mill with circuits of the utility for joint or parallel operation. The power tie often requires major modifications in the mill electrical system. New problems and methods of plant operation are usually encountered.

Total cost to the mill to make a major utility connection is usually considerable. Final cost estimates are often much higher than anticipated during initial stages of investigation. Appreciation of the more important factors of installation and operation of such power ties is, therefore, desirable.

Two major requirements are: (1) Interconnecting power circuitry should be adequate to meet the rigid requirements for continuity of service to the mill's principal product-producing departments. (2) Interconnection should be made at minimum initial cost commensurate with the mill's needs for prime circuit flexiblity and future growth requirements. *AIEE paper No. 54-243.*

Electric power distribution at Norton Co, Grinding Machine Div, Worcester, Mass. *By Paul Russell, General Electric Co.*

Widely heralded as the factory of the future, this is one of the most complete straight-line production machine-tool plants in the world today. The building covers seven acres devoted to factory and offices.

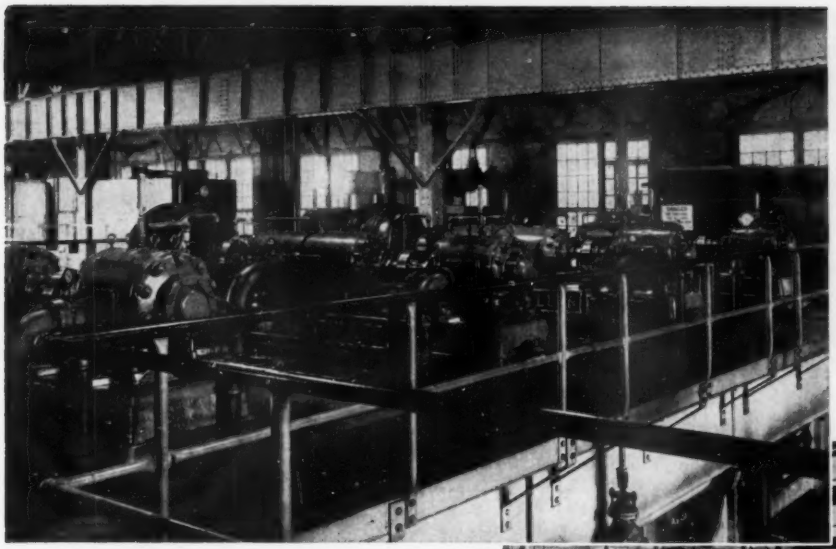
Two 13.2-kv feeders run underground to the plant from the main substation of the Norton Co. Either can carry the entire plant load—only one is used at a time. A power-company loop ties into the main substation bus and the symmetrical short circuit kva here is about 300,000. A 15-kv 500-mva circuit breaker at each end of each line gives short-circuit protection and transfer switching operation.

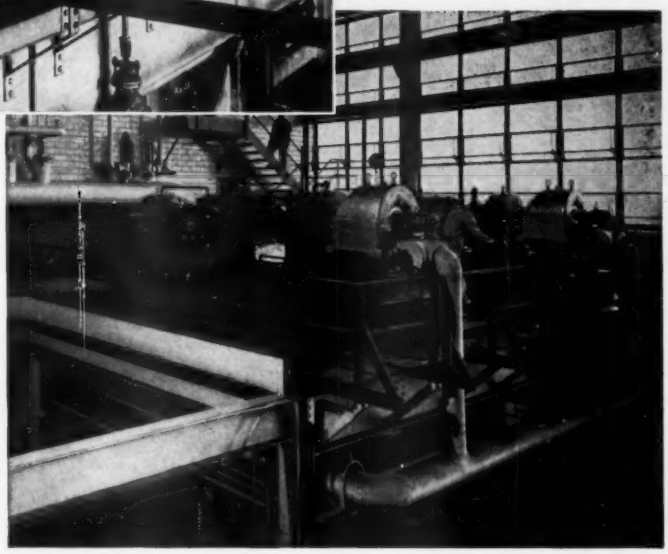
The two cables are brought into the plant and up to the mezzanine where the two load-end line breakers are aligned alongside a 2000-kva double-ended unit substation. A 13.2-kv radial feeder loops from the 13.2-kv bus to the two high-voltage entrance compartments of the substation and to a third substation used for supplying power to the heat-treating department.

Each transformer may be isolated from the high-voltage line by air-filled interrupter switches, interlocked with the transformer main secondary breakers so they interrupt only transformer magnetizing current.

The plant ground was established by

Directions for ordering papers on p 152





Views of Fuller Rotaries installed on balconies; overhead, out of the way. Left: Four two-stage; capacity each 1665 c.f.m., 100-lb. psig. Below: Two two-stage; capacity each 1592 c.f.m., 120-lb. psig.

Eliminate heavy, costly foundations with FULLERS

*** simple * compact**

*** direct drive * valveless**

*** vibrationless * pulseless**

If you've never considered the many outstanding advantages of Fuller Rotary Compressors and Vacuum Pumps, now is the time to do so.

Fullers have many unique and beneficial advantages for low cost operation. They can be placed almost anywhere out of the way, because their vibrationless, rotary action permits installation, for example, on a balcony or upper floor of a building . . . no heavy, costly foundations being required. Operated by direct drive, you reduce initial and maintenance costs, as well as transmission losses incident to gear and belt drives.

Because Fuller Rotaries compress without reciprocating motion the air-stream is, in effect, non-pulsating. They're extremely compact for volumes delivered; sizes are available to deliver up to 3300 c.f.m., actual free-air, for pressures to 125 psig., from atmosphere.

Write today to Fuller Company—have one of its compressor engineers recommend the *right* compressor for your operation—one that will give you life-time efficiency and capacity.

Fuller

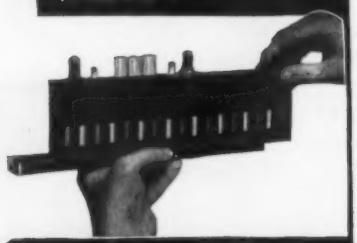
Pioneers of high efficiency vane-type rotary compressors

FULLER COMPANY
Catasauqua, Pa.

Branch Offices: Chicago • San Francisco • Los Angeles • Seattle • Birmingham

C-239
2156

Want the easiest way to make fast, accurate **BOILER WATER pH, PHOSPHATE TESTS?**



TAYLOR COMPARATORS

EASIEST...

because three simple steps give you the determination; every Taylor set is supplied with all necessary reagents and accessories. And, Taylor sets are lightweight, yet strongly built.

FAST...

because many tests can be made in only a few seconds. Others take no longer than a few minutes. Taylor sets are compact, portable so you can make tests on-the-spot, no time wasted carrying samples back to the lab.

ACCURATE...

because all Taylor liquid color standards carry an unlimited guarantee against fading.

All standards for any one determination are housed in a single plastic slide. No single standards to handle. Many different slides can be used on one base.

See Your Dealer Soon!

FREE MANUAL

"Modern pH and Chlorine Control" illustrates and describes full Taylor line. Also gives useful data on theory and application of pH and Chlorine control. Write today.

W. A. TAYLOR AND CO.
YORK RD. & STEVENSON LANE • BALTO. 4, MD.

More TECHNICAL BRIEFS

Begins on page 150

driving 12-ft copper ground rods about 50 ft apart around the periphery of the building and connecting these ground rods with 4/0 bare copper wire laid in the ground. Taps are run from the bare copper loop to the building steel at many points around the structure. Another 4/0 bare copper line runs lengthwise of the mezzanine and connects into the ground loop to furnish a ground for the substation equipment. All machines are grounded directly to this loop or to the building steel.

Four breakers on each substation are used to feed busway radial feeders to the power load in the plant. Depending on the load concentration, 225, 400 and 600 amp busway of the plug-in type was used for greater ease of installation.

The paper concludes by comparing some statistics on this setup with standard estimating data. Total plant cost was 6 million dollars, of which about $500,000 or 8.3% was for electrical equipment. This checks closely with the usual estimate of 10%. Lighting demand factor is 0.061 for the factory, as compared with an estimated 0.065 volt-amp per square foot per foot-candle. Lighting load is about 25% of the total connected load, somewhat higher than usual. Load density is about 8 volt-amp demand per square foot, about average for plants of this type. *AIEE paper, no number.*

Diesels

Maintenance and operation of the Tacubaya diesel plant, Mexico City. *By J K Jennings, The Mexican Light & Power Co.*

Total capacity of Tacubaya is 30,900 kw, each of the six Nordberg diesels having a sea-level rating of 8650 hp at 167 rpm. Placing them side by side in the central aisle, with auxiliaries in a side aisle, gives a spacious arrangement that greatly facilitates maintenance.

The plant has been in service five years. From the beginning, special attention has been given to record keeping to permit easy and accurate evaluation of every change and experiment made.

Highest outputs occurred during 1949, '50 and '51 when load factors reached as high as 87%, with engine availability as high as 92%.

Careful studies show the main causes of forced outages include mechanical failures, piston-ring failures, cylinder lubrication, crankcase lubrication, blower motors and vibration. A number of tables give a complete analysis of plant operation, including the causes of various outages. *ASME paper No. 54-MEX-20.*

3 steps to cutting maintenance time on boiler gauges

1 **Check glass before installing.** Is it cut evenly at both ends? Is it free from chips or scratches? Is it heavy enough for pressures you expect to use? An incorrect glass will only have to be replaced later, and the "savings" of a hurried installation will be lost.

2 **Always keep two spares.** When ordering gauge glasses, ask for "1 for each gauge, and 2 for the shelf." This gives you a quick, correctly sized replacement in case of emergencies. No hunting around the shop, no hurried phone calls to your distributor.

3 **Don't take chances.** A cheap gauge glass may save you a nickel today, and cost ten dollars in repairs. PYREX brand gauge glasses have balanced properties of heat-shock resistance, chemical stability and physical strength. You get easy reading and economical long life. Order from your Industrial Distributor today . . . and remember, two spares for every gauge.

CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

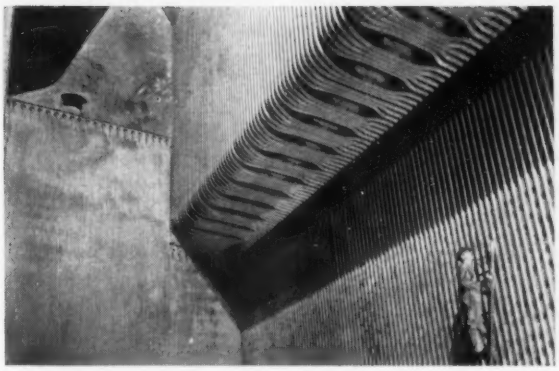
Application	Recommended Product
Normal Conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
Higher temperatures	PYREX brand high-pressure gauge glasses
Higher pressures	PYREX brand heavy-wall gauge glasses
Extra visibility	PYREX brand red-line gauge glasses
Viewing inside furnaces, reactors pressure vessels, etc.	PYREX brand sight glasses
Lubrication inspection	PYREX brand lubricator glasses
Visible discharge devices	PYREX brand oil cup glasses

PYREX T.M. REG. U.S. PAT. OFF.

CORNING GLASS WORKS
Corning, New York

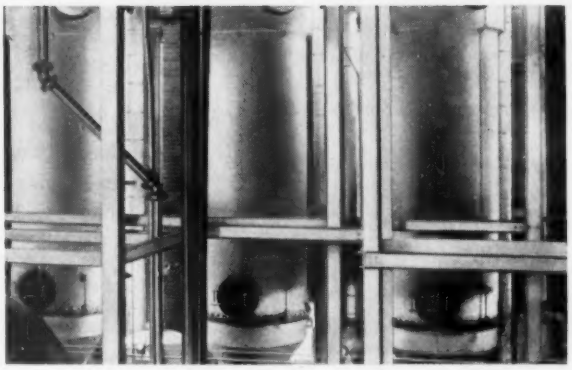
Corning means research in Glass

There's no limit to what you can do with the right tubing!



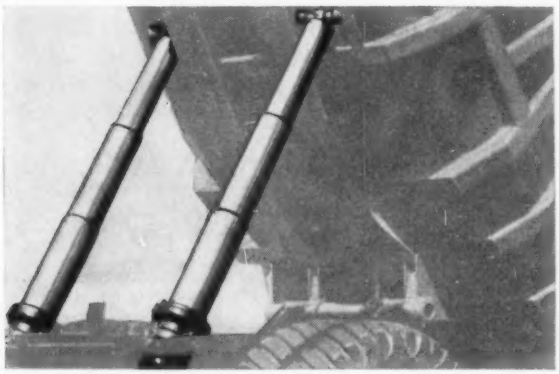
make power to light a city . . .

There are more than 12 miles of Globe seamless pressure tubing (carbon, alloy, and stainless) in this modern boiler which is a vital part of the electric power plant that serves a large metropolitan community.



transfer corrosive liquids . . .

Black liquor, used in production of kraft papers, is highly corrosive and has to be carried under pressure in multiple effect evaporators. Gloweld (electric welded) Stainless Steel Tubing was found to do the job best—at lowest cost.



or lift a load of dirt . . .

Mounted on a dump truck, these twin hydraulic hoists are built to handle heavy loads. Design and production is simplified by making the telescoping arms of Globe mechanical tubing.

THERE are probably a thousand and one different tube applications that could be made in your own products or industry. Check the possibilities. Globe engineers will be pleased to give helpful advice on how the right tubing — Globe tubing — can help you save time, save money, save manpower. Write for literature on any of these products.

GLOBE STEEL TUBES

GLOBE STEEL TUBES CO.
MILWAUKEE 46, WISCONSIN

Field Offices: Chicago • Cleveland • Detroit • New York
Philadelphia • St. Louis • Denver • Houston
San Francisco • Glendale, Calif.

A quick check list of GLOBE STEEL TUBES

ALLOY STEEL: to meet heat, corrosion, pressure, and structural strength problems. Carbon Moly, Chrome Moly Nickel and others. Sizes: O.D. from ½ to 6 inches. Wall thickness .035 to 1.000 inch.

CARBON STEEL: for load bearing structural members with strength, least weight . . . for fast, low-cost manufacturing of machine parts or pressure tubing applications. Low and medium carbon. Sizes: O.D. ½ to 7½ inches. Wall thickness: .028 to 1.000 inch.

STAINLESS SEAMLESS: in sizes from ½ inch to 6 inches O.D., and in pipe sizes ⅛ inch to 6 inches, standard, extra strong and double extra strong weights.

STAINLESS WELDED: Gloweld electric welded stainless steel tubing offers many economies. Sizes: O.D. ¼ to 5 inches. In standard wt. pipe sizes ⅛ to 2 inches. In lightweight pipe sizes ⅛ to 4½ inches inclusive.

HIGH PURITY IRON: Globeiron tubing is 99.5% pure ingot iron. For applications where ductility, toughness, easy weldability and easy forming are desired or for use where magnetic permeability and electrical properties are required.

SPECIAL ANALYSES: Globe Steel Tubes Co. regularly produces tubing to special customer specifications. Consult with Globe's representatives for analyses to suit your needs.

GLOBE WELDING FITTINGS: seamless, carbon and stainless, available in a complete line of sizes and weights through Globe distributors in key cities.

SAVE MONEY

WITH "BARNEY" CONDENSATE TILT TRAPS for Boiler Feeding and Steam Drainage

- Increases boiler efficiency by returning condensate at high temperature to boiler
- Engineered construction—features fewer parts
- Requires little lubrication
- Provides constant deaeration and excess pressure release

"WEAROCK LINING"*

We also line hot water tanks with "Wearock Lining". Ideal for dairies, hospitals and all installations where water of high purity is important.

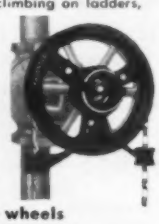
*"Wearock Lining" is guaranteed for 10 years.

LAKEWOOD MANUFACTURING COMPANY
25039 Center Ridge Road
Westlake, Ohio

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

Control out-of-reach overhead valves right from the floor! No more climbing on ladders, balancing on boilers, perching on workbenches or machines. Prevent accidents and costly claims — also save fuel, steam and money.

Only four simple, quickly-assembled parts installed and operating in only a few minutes, Babbitt Adjustable Sprocket Rim with Chain Guide —



- **Fits all valve wheels**
- **Simplifies pipe layouts**
- **Eliminates risky climbing**

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

Call your Industrial Distributor. He carries complete stocks. Or write for descriptive folder and prices.

Babbitt STEAM SPECIALTY CO
2 BABBITT SQUARE, NEW BEDFORD, MASS.

More POWER NEWS

Begins on page 148

Wind Tunnel

enough to spot even smoke wisps straying below the main body of smoke.

After correlating field and tunnel tests, the research team studies effectiveness of several means of reducing gas downwash. These include higher stacks, nozzles or vanes to guide exhaust gases, diluting gas with air to increase its speed as it leaves the stack and using vanes to correct unfavorable wind patterns caused by the plant building.

C F Roth, power show manager, dies June 24

► CHARLES F ROTH, president of the International Exposition Co and manager of the 21st National Power Show, died June 24 in Northern Westchester Hospital, Mt Kisco, N. Y. Mr Roth had been associated with the International Exposition Co since 1923. He was named president in 1937.

Mr Roth was involved in some aspect of engineering or chemistry from the time he was graduated from Cooper Union in 1912, until his death. He was associated with the Power Show from the time of its inception in 1922 until the present.

Combustion Engineering head receives honorary degree

► MARTENS H ISENBERG, president and director of Combustion Engineering, Inc, was named an honorary doctor of engineering by Brooklyn Polytechnic Institute in the 99th commencement ceremonies of that school on June 16.

Isenberg's doctorate was awarded for his "contribution to [the] great power industry, so basic to American standards of living . . ." President Harry S Rogers of Polytechnic presided. Isenberg is an alumnus of Polytechnic in the class of 1915. He has been with Combustion Engineering since 1916 and was elected to the presidency in April, 1953. He recently was a recipient of BPI's alumni association Public Service Award for his accomplishments in the field of engineering.

Okonite Co receives order for 230 kv underground cable

► THE OKONITE CO of Passaic, N. J., received an order recently for a 230 kv Oilostatic cable to be delivered to the Canadian-Brazilian Services Ltd, Toronto, Can., for subsequent installation in the Cubatao Underground Power Plant of the Sao Paulo Light and Power Co, Ltd, Sao Paulo, Brazil. This is the first time an American manufacturer has received an order for an underground cable of such high voltage.

Changing Address ?

If you are planning to move, please be sure to let our Circulation Department know about it—and as far in advance as possible.

It takes time to correct the stencil addressing plate and to make the correction on all our records. So your prompt notification will help us make sure you do not miss copies of POWER.

Be sure to give us your OLD address as well as your NEW address. We need them both to make the correction—*also confirmation of your company connection and position.*

Mail in the coupon if you plan to move. And please fill it in as completely as possible.

THANK YOU!

Circulation Dept.
POWER
330 West 42d St., New York 36, N. Y.

Change of Address Notice
(PLEASE PRINT)

On or about .....

my NEW address will be

Street .....

City ..... Zone .....

State .....

Position .....

Company .....

No. of Employees .....

My OLD address was

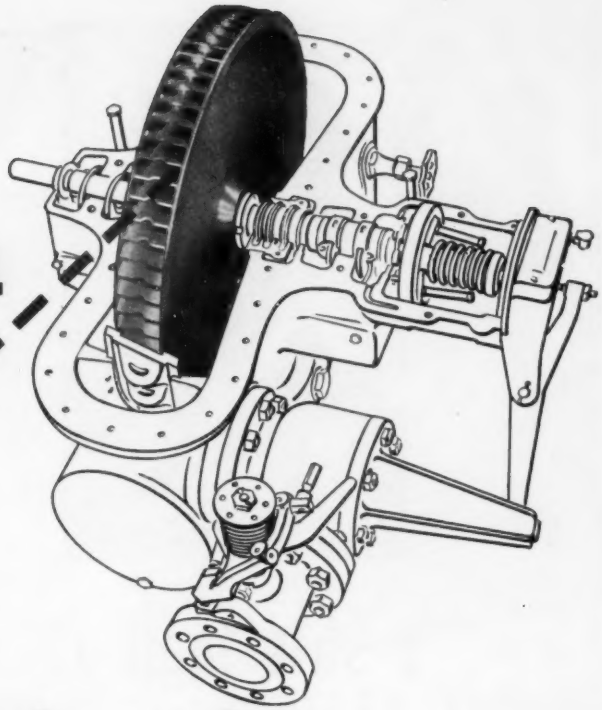
Street .....

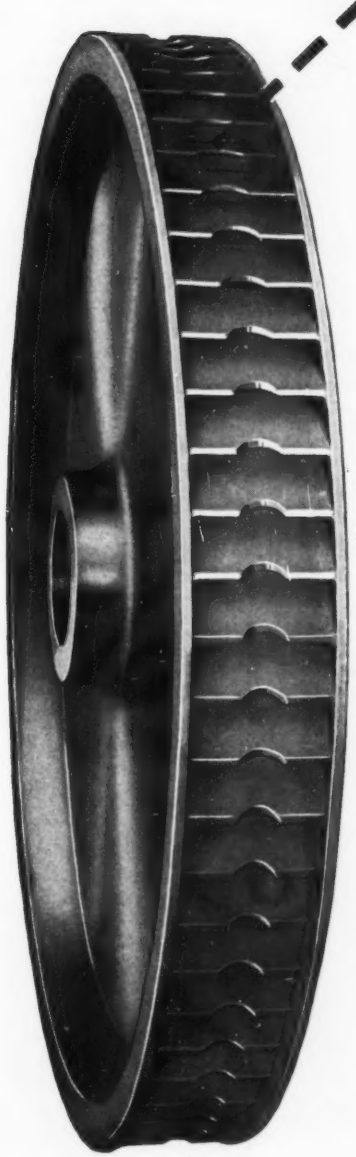
City ..... Zone .....

State .....

.....
Name Here

TERRY SOLID WHEEL





..."trade mark" of a trouble-free turbine

This is the rotor of a Terry solid-wheel turbine. There are a number of reasons why it has become a symbol for reliable, trouble-free operation.

First, because the wheel is a single forging, in which a series of semi-circular buckets is milled, there are no separate parts to become loose or work out.

Second, because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets, blade wear is of little consequence. Wear does not materially affect horsepower or efficiency.

Third, because the steam enters the buckets in a direction at right angles to the shaft, there is no need for close axial blade clearances. The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, the blades are double rim protected.

These are only a few of the reasons why the Terry solid wheel has become a "Trade Mark" for trouble-free turbine performance. For complete details, send for a copy of bulletin S-116. No cost or obligation.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1197

a ship load of wonderful Marmaduke stories and only $1

Here are 21 of Marmy's most fabulous engineering exploits, exactly as they appeared in the pages of POWER. Generously illustrated and bound in varnished red cover. It's a collection any engineer will want to read and re-read. Only one dollar, postpaid. Supply is limited, order today.

POWER

330 West 42 St., New York 36, N.Y.

Enclosed please find $_____ for which send me _____ copies of "The Marmaduke Story" at $1 per copy.

NAME _____

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APPOINTMENTS

Corporation Executive Changes

Stauffer Chemical Corp: James W Kettel, appointed controller. **Midwest Piping Co:** Guy L Morrill elected vice president. **Shawinigan Water & Power Co:** Russell R Merifield succeeds J L T Martin as secretary. **Tucson Gas, Electric Light & Power Co:** C E Hockings named director to replace the late J H Saunders.

Operations Executive Changes

Worthington Corp: Fenmore E Dunn named general manager of Vertical Turbine Pump division. **General Motors Corp:** Robert S Johanson succeeds the late M W Gotthelf as public relations director of the AC Spark Plug division.

Engineer Changes

American Locomotive Co: Kenneth Kasschau named manager of engineering of new atomic energy products department. **General Electric Co:** Howard M McNeil named wire and cable specialist for Construction Materials div. **West Penn Power Co:** J F McQuillin appointed manager of methods engineering department.

New Distributors

For Carboloy Dept of **General Electric Co:** Industrial Tool & Supply Co, San Jose, Calif. For **Ampco Metal, Inc:** Davis Emergency Equipment Co of New England, Melrose, Mass.

New Representatives

For **Conoflow Corp:** The Watts Co, 4101 San Jacinto St, Houston 4, Texas. For **Electrical Engineers Equipment Co:** K H Newbury Co, 1016 Nicolet St, Green Bay, Wis. For **DeLaval Steam Turbine Co:** Maquinaria Industrial Ltda, Bogota, Colombia, S.A. For the **Swartwout Co:** W H Cress Co, Portland, Ore. For **Orr & Sembower, Inc:** Ogle Engineering Sales, Louisville, Ky.

Recent Moves

Bailey Meter Co: Los Angeles, Calif district office, new office at 816 S Atlantic Blvd, Monterey Park, Calif. **North American Phillips Co, Inc:** Research and Control Instruments div, new regional office at 4959 W Diversey Ave, Chicago 39, Ill. **Bailey Meter Co:** Cincinnati district office to 2330 Victory Pkwy, Cincinnati 6, Ohio.

Retirements

E C Shields: vice president and general sales manager of the Rockford Clutch div, Borg-Warner Corp, after 25 years. **Fred H Schonberger:** Philadelphia sales representative for Carboloy Dept, General Electric Co.

Obituaries

Herbert A Bernreuter, 53, vice president and general manager of Simpson Electric Co, in June. **Nathaniel R Richardson,** 56, vice president and works manager of Electric Controller & Mfg Co, June 14.

TAKES THE BLOW OFF...
CUSHIONS SHOCK

PENFLEX TUBING

ABSORBS THERMAL EXPANSION... PREVENTS BLOW-OUT

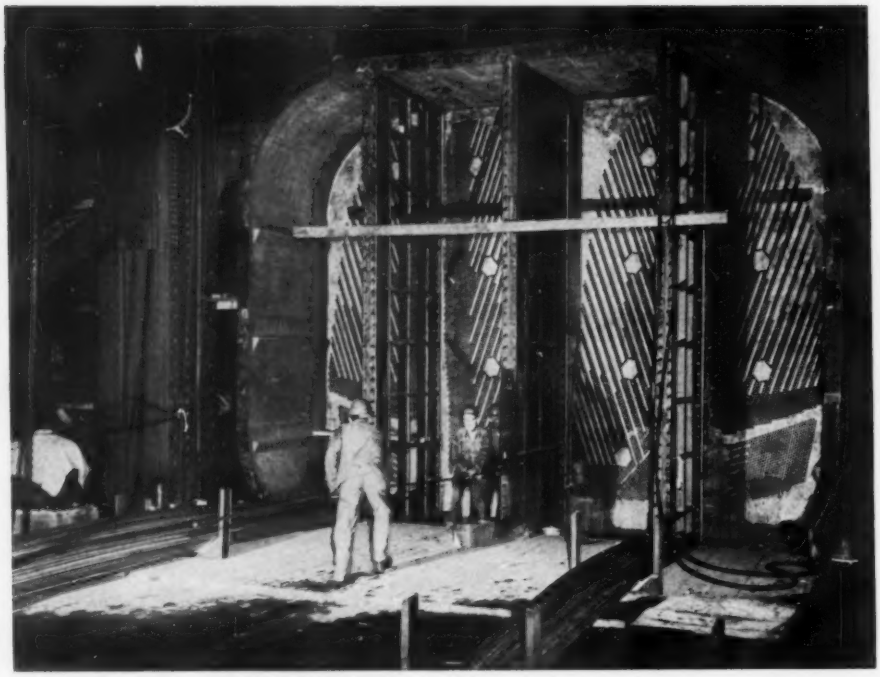
WHEN SAFETY VALVES pop in this large industrial plant, a terrific surge of 900°F. steam blasts through the blow-off pipes under as much as 850 psi pressure. Ordinary pipe would blow apart. But Penflex Flexible Metallic Tubing has enough "give" to take the shock. Six lengths of 8" Penflex interlocked tubing cushion the sudden impact . . . take up any pipe movement due to extreme temperature and pressure changes.

The Penflex Engineer can help you solve your tough tubing problems. A complete line of Penflex Flexible Metallic Tubing, Hose, and Couplings is at your disposal—4-wall interlocked and seamless welded corrugated tubing and metallic hose from 1/8" to 24" I.D. . . . automatic barrel fillers, pneumatic rivet passers, and fittings. Write for the new illustrated data book, "Flexineering."

Pennsylvania Flexible Metallic Tubing Company, Inc.
7237 Powers Lane, Phila. 42, Pa.
Offices: **Boston • New York • Chicago • Houston • Cleveland • Los Angeles**

PENFLEX

HEART OF INDUSTRY'S LIFE LINES



Aluminum Brass Tubes being installed in the world's largest surface condenser. More than 104 miles of tube are being used. As work progresses, platform is gradually raised. (Courtesy Consolidated Edison, New York)

World's Largest Single-Pass Surface Condenser Uses Arsenical Aluminum Brass Tubes

A giant new condenser with a total surface area of 125,000 square feet is being installed at the East River generating station of the Consolidated Edison Company of New York.

It contains 18,360 Arsenical Aluminum Brass Tubes, 7/8 inch O.D., No. 18 BWG, each 30 feet in overall length. Laid out in a straight line, these tubes would extend for 104 miles.

The new condenser is a horizontal, single-shell, single-pass unit with vertically divided water boxes. According to the manufacturer, Worthington Corporation, it is the largest condenser of its type ever built.

Generating Capacity Increase

East River station's net capacity is now 589,000 kw. When Unit No. 7 goes into operation in the Spring of 1955, the net station capacity will be about 762,000 kw. The new turbine combination is rated at 180,000 kw, 3600/3600 rpm. Each generator is rated at 100,000 kva, 0.8 power factor, 3-phase, 60-cycle and 13,800 volts, with ½ lb. hydrogen cooling pressure.

The unit's low-pressure element, comprising two double-flow turbines on a single shaft, will exhaust into the condenser, which is guaranteed to condense 980,000 pounds of steam per hour with a back pressure of 2 inches of mercury absolute when provided with 130,000 gallons of water per minute at 75 degrees Farenheit. Since the average temperature of river water used for condenser cooling is well below 75 degrees, the condenser is expected to maintain a back pressure of less than 1 inch of mercury absolute for most of the year.

Aluminum Brass Tubes

Arsenical Aluminum Brass was selected by Consolidated Edison Company of New York engineers, on the basis of many years of very satisfactory service, as the most economical condenser tube alloy for long, trouble-free life at this station. The alloy selection is particularly important in view of the corrosive nature of the East River water used in the condenser. Although called a river, this body of water is by nature actually a tidal flow with considerable corrosive characteristics because of its salt water, and industrial and urban waste content.

Bridgeport's Arsenical Aluminum Brass Condenser Tubes (Alloy No. 54) are among those used in this huge new condenser unit. Tubes of this alloy are giving excellent service in many other plants at tidewater locations. In these installations, the economy of using Bridgeport Arsenical Aluminum Brass has been proved by long tube life, reduced maintenance, and more efficient operation.

Bridgeport's Technical Service and Corrosion Laboratory are always ready to help you select the most economical Bridgeport Condenser Tube Alloy for your installation. Call your local Bridgeport Sales Office to use these services to your advantage.

BRIDGEPORT BRASS
COMPANY ◆ BRIDGEPORT, CONNECTICUT
Serving Industry with a Nationwide Network of
Conveniently Located Sales Offices and Warehouses
Mills at Bridgeport, Conn., Indianapolis, Ind. and Adrian, Mich.
In Canada: Noranda Copper and Brass Limited, Montreal
Bridgeport

$ave Power and REFRIGERATION COST

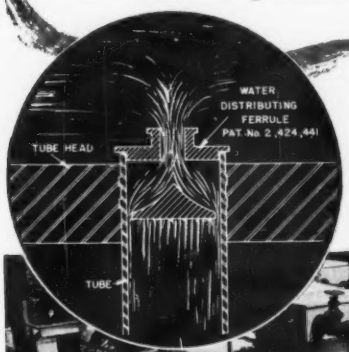
Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

Horizontal Multipass Condensers
(Closed Type)

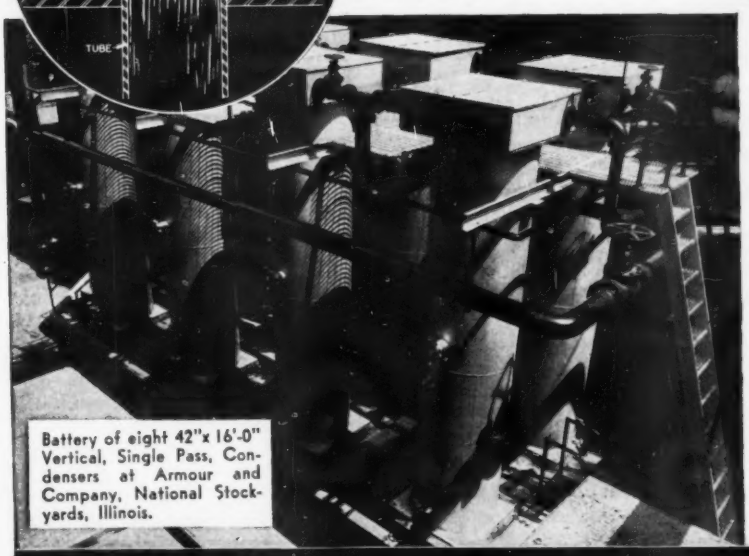
Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.



Vertical Single Pass Condensers
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

Write For Bulletin RC-1

HENRY VOGT MACHINE COMPANY
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Vogt REFRIGERATION CONDENSERS

Actual Figures... *NOT Claims*

Prove that AMERICAN "WC" coal crushers are top performers at low operating costs!

CRUSHING FACTS
based on User-Reports from
12 Power Plants & Coal Mines

Total Tonnage Crushed:
1,507,827 tons
Parts Replacement Cost:
$0.0028 per ton

When the actual tonnage figures (as supplied by the Chief Engineers of power plants and the Preparation Engineers of coal mines) are compared with the total cost of replacement parts ordered, the real story of the quality and efficiency of American "WC" Coal Crushers is apparent—the story given in the panel above.

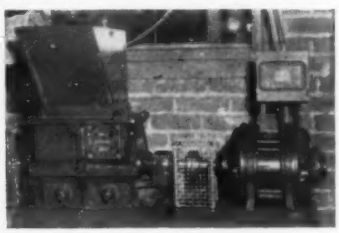
With American, quality is not a mere claim, nor even an isolated performance story. It is based on the consistent pattern of high-tonnage-at-low-maintenance for *all types* of American coal crushers—a record directly traceable to the efficient crushing action of the American-originated rolling-ring crushing principle, plus a half century of specialized experience in building coal crushers.

American "WC's" are designed for capacities up to 90 tons per hour . . . but whether your requirements range from coal sampling up to 600 tons or more per hour, American has the crusher to handle your job at the lowest possible cost.

WRITE FOR COMPLETE INFORMATION AND LITERATURE

. . . and for low-cost coal sample crushing

Model 9-9 American Laboratory Crusher, one of several sizes for reducing coal samples prior to analysis.



American
PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.

Waneta's gravity type dam has a length on top of 950 feet and provides a head of 210 feet. The spillway allows for a maximum flow of 280,000 cubic feet per second.

WANETA *on the* PEND d'OREILLE

For The Consolidated Mining and Smelting Company, Trail, British Columbia, Stone & Webster Canada Limited, in collaboration with Stone & Webster Engineering Corporation designed and constructed the Waneta Hydroelectric Development.

Waneta, located on the Pend d'Oreille River just above its confluence with the Columbia, is designed for an ultimate capacity of 480,000 hp.

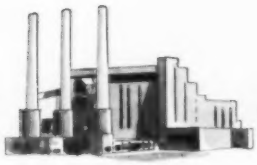
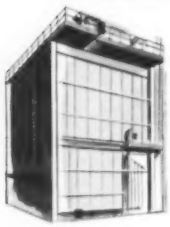
The first two units, of 120,000 hp. each, are already on the line.

Write or call us for detailed information as to how our engineering, design, construction, report and appraisal services may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Toronto

In the 267 new  central station units being started in 40 different states during the 1953-56 period, 75% of the  boilers will be equipped with Consolidated Maxiflow Safety Valves ...35% will also have Consolidated Electromatic Relief Valves. These bulletins tell you why.

Consolidated Maxiflow Safety Valve BULLETIN 707 contains data about the greater discharge capacity, permanent tightness and easily controlled blowdown that make this valve outstanding in safety and service.

Consolidated Electromatic Relief Valve BULLETIN 720 tells how this valve assures (1) more accurately balanced boiler operation; (2) more uniform line pressure; (3) power conservation; (4) less maintenance of spring-loaded safety valves; (5) greater protection against overheating your superheater; (6) increased efficiency for your steam generating plant.

Both bulletins give complete specifications. Write for copies.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

KIRK AND BLUM

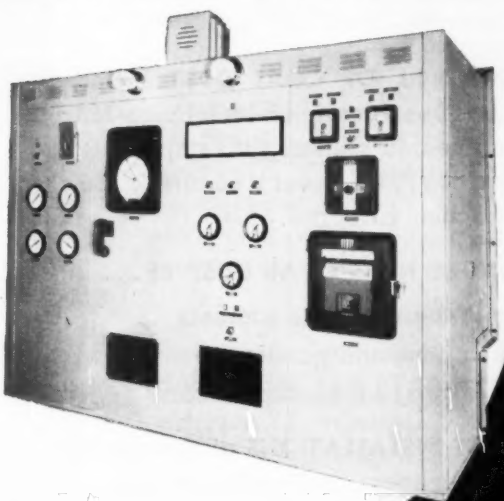
CONTROL PANELS and DESKS

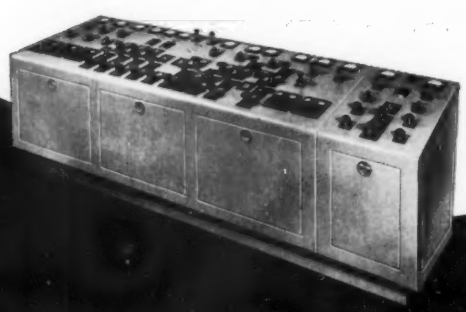
for INDUSTRIAL PLANTS and UTILITIES

For fabrication of control panels, desks and consoles, in any size, in any quantity . . . for any power plant requirement, call on Kirk & Blum.

Steel and alloy fabrication . . . sheets, plate and light structurals . . . has been a Kirk & Blum specialty for more than 47 years. Exceptional experience and complete facilities up to ½" in steel, stainless, aluminum, monel and other alloys.

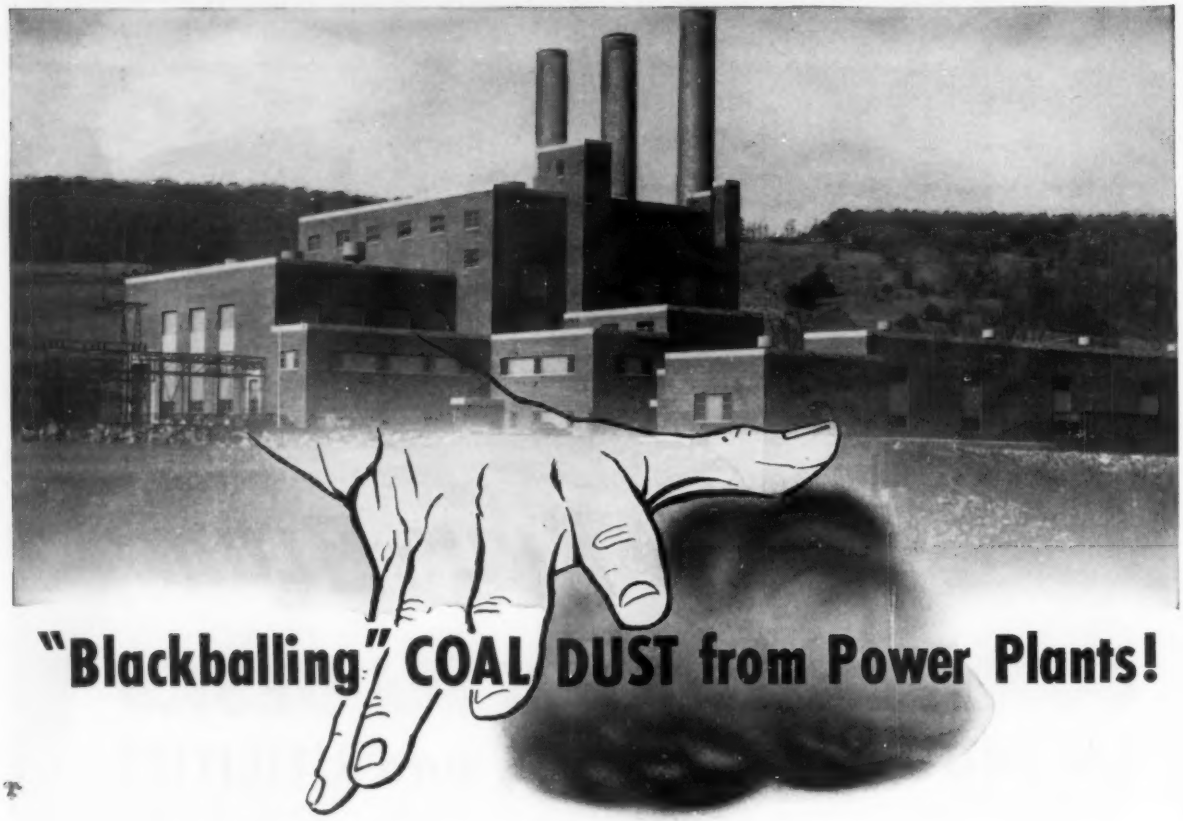
Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication catalog. The Kirk & Blum Mfg. Co.,3233 Forrer St., Cincinnati 9, Ohio.





KIRK AND BLUM

SHEET METAL FABRICATION



"Blackballing" COAL DUST from Power Plants!

THE CONTROL OF COAL DUST in power plants has been perfected by Johnson-March with engineered systems that stop coal dust at its source . . . wherever it occurs . . . before it can become airborne.

NO LONGER NEED COAL DUST BE . . .

- a maintenance problem
- a community nuisance
- a fire or explosion hazard

LOW-COST INSTALLATIONS at car dumpers, crushers, hoppers, belt galleries and coal piles are successfully eliminating coal dust in many leading power plants throughout the country. Similarly, fly ash handling and disposal need no longer be a dust problem. No costly ducts, hoods or fans to interfere with normal operations. First cost is 1/10 that of other systems and maintenance cost is next to nothing.

JOHNSON-MARCH ENGINEERED SYSTEMS are used in many plants to supplement and improve the effectiveness of existing mechanical dust collection systems. If you now have such a system, or if you have no control over coal dust, let Johnson-March engineers analyze your dust problems and recommend an economical "custom-made" system that will eliminate your plant and community dust nuisance. Write for full details.

Johnson March

Dust Control Engineering

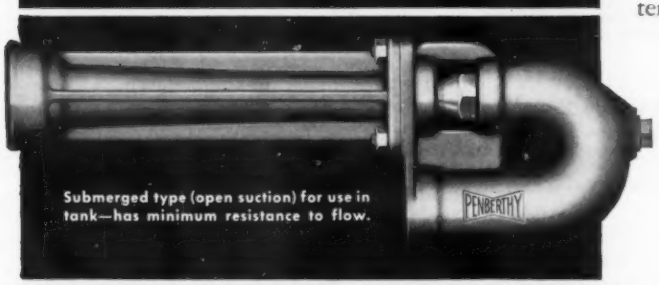
DEPT. P, 1724 CHESTNUT STREET, PHILADELPHIA 3, PA.

LOW COST...
COMPACT...
TROUBLE-FREE...

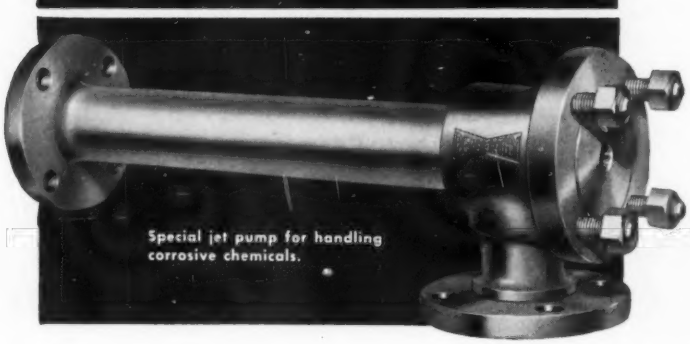
PENBERTHY
JET PUMPS

Hydraulic ejector for lifting, elevating and blending of liquids and slurries.

Steam or air operated ejector for a wide range of operating conditions.



Submerged type (open suction) for use in tank—has minimum resistance to flow.



Special jet pump for handling corrosive chemicals.

Consider the simplicity of the jet pump. It uses steam, water, air or gas under pressure to transfer or mix, without clogging, *any liquid which will flow through pipes.* It has no moving parts or packing glands. Needs no lubrication or maintenance. It's practically noiseless, costs little and is compact.

Penberthy makes a full range of jet pumps. They are being used in standard and unusual applications. Where necessary, they are made to withstand corrosion, contamination and high temperatures.

Penberthy, from wide experience, can help you save time and money, increase the efficiency of your operation. Take the first step by writing for Bulletin No. 512 which details the complete line of jet pumps by Penberthy.

★

Established 1866

PENBERTHY INJECTOR COMPANY

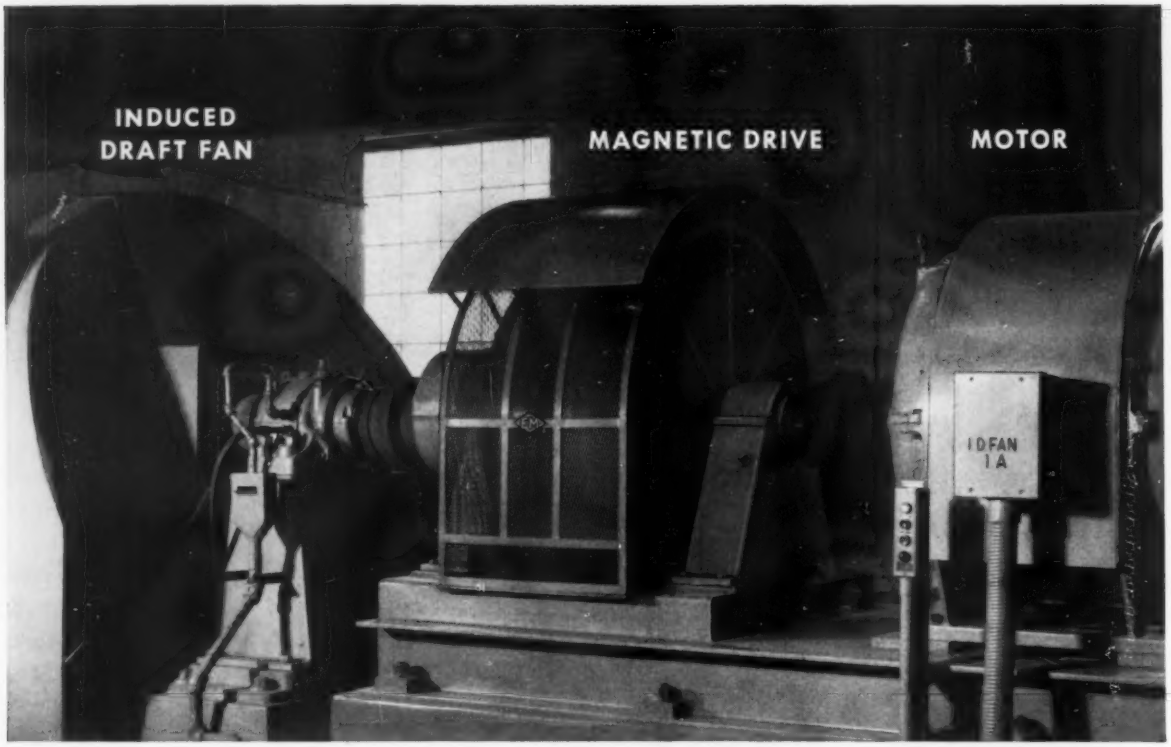
Division of the Buffalo-Eclipse Corporation

1242 Holden Avenue
Detroit 2, Michigan

There's Certain satisfaction in **PRODUCTS BY**

PENBERTHY

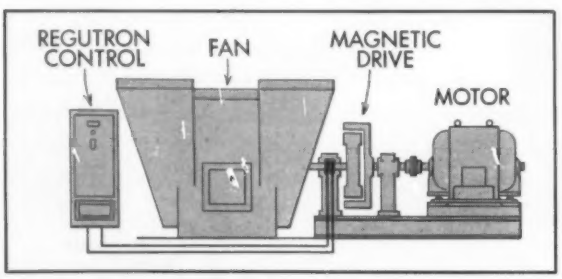
- **CYCLING JET PUMPS**
- **EJECTORS**
- **INJECTORS**
- **ELECTRIC SUMP PUMPS**
- **DUCTORS**
- **EXHAUSTERS**
- **SYPHONS**



Now 18 E-M Magnetic Drives for Potomac Electric Power Company

● The clean, compact E-M Magnetic Drive above gives adjustable speed for an induced draft fan at the Potomac Electric Power Company Buzzard Point plant, Washington, D.C. This Drive is rated at 550 hp, 850/90 rpm. The first Magnetic Drives were installed by this large, rapidly growing utility in 1941.

These E-M Magnetic Drives transmit torque electromagnetically from constant-speed a-c drive motors to vary the speed of the fans. The Magnetic Drive responds precisely to the speed dictated by the automatic combustion control.



E-M MAGNETIC DRIVE SYSTEM for induced draft fan speed control consists of a constant-speed motor, the Magnetic Drive, and the E-M "Regutron" Speed Control. Operating speed of the "magnet" coupled to the fan shaft is held at the desired value by the "Regutron" which supplies d-c excitation to the "magnet" in accordance with the demands of the combustion control system.

Among the advantages of Magnetic Drive speed control you will find:

1. **Savings in Driving Power.** Because fan operating speed is no more than required, drive power is used most sparingly.
2. **Reduced Blade Erosion.** When boiler load is reduced and fan speed is reduced accordingly, "sand blasting" effect on the blades by airborne particles is reduced to a minimum.
3. **Precise Control of Air Flow.** The E-M Magnetic Drive maintains fan speed to within plus or minus *one-half percent!*
4. **Easy and Economical Maintenance.** The Drive and its control contain few moving parts. It is simple to understand and requires little maintenance. No auxiliary cooling equipment needed.

Ask your nearest E-M sales engineer for more facts and figures on this simple, economical method of driving draft fans. And write the factory for E-M Publication No. 1107 containing pictures and data on typical Magnetic Drive applications.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

4400-TPA-2151

E-M

Magnetic Drives **MAKE DRAFT FANS DO EXACTLY WHAT YOU WANT THEM TO**

Have you a fly ash recovery problem?

Bring it to
WESTERN PRECIPITATION

... The Only Organization With Years Of "Know-How" In BOTH *Electrical* And *Mechanical* Recovery Methods!

If you have any kind of a suspension-recovery problem—whether dust, fly ash, fume, fog or mists—it will pay you to bring it to the leading organization in the field ... WESTERN PRECIPITATION CORPORATION. Western Precipitation not only pioneered, over 44 years ago, the first commercial application of the now-famous COTTRELL Electrical Precipitators, but also has been a leader for many years in the *mechanical* recovery field with its widely-accepted MULTICLONE Collectors.

Result:

Western Precipitation is unsurpassed in the all-important factor of "know-how" in BOTH the electrical and mechanical fields ... knows from years of first-hand experience whether your particular problem can best be solved by mechanical or electrical methods—*or by a combination of the two* ... can give you a direct and unbiased recommendation on the matter ... and then can provide the complete installation under *one* responsibility, *one* overall performance guarantee, even where Combination Multiclone-Precipitator (CMP) installations are made!

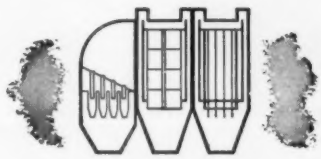
Western Precipitation products and services include ...

COTTRELL
Electrical Precipitators

... the most efficient recovery equipment for high recovery, long life, low maintenance on practically any type of suspensions, wet or dry. COTTRELLS can be designed to handle a few c.f.m. —or millions—with equal ease, and at virtually any operating temperature. Recovery efficiencies closely approach 100% recovery, if desired, with very low draft loss, minimum power costs and negligible labor costs. ***By all standards, Western Precipitation COTTRELLS give highest recovery at lowest cost per-year-of-service!***

MULTICLONE
Mechanical Collectors

... the most efficient, most compact, most trouble-free mechanical equipment for recovering suspensions from gases. Because of their unique small-tube design, MULTICLONES are unsurpassed in mechanical recovery efficiencies—require less space, less maintenance, and are far simpler to install. No filters or screens to replace, nothing to burn or cause fire hazards, no high speed moving parts to repair or replace. These and many other advantages make MULTICLONE Collectors the logical choice on installations where mechanical recovery is selected.



CMP UNITS
(Combination Multiclone-Precipitator)

... combine, in *one* compact installation, *both* mechanical and electrical recovery principles so that maximum benefit is obtained from the advantages inherent in each method. The MULTICLONE section centrifugally removes the larger and heavier suspensions (down to a few microns in diameter) ... and the COTTRELL section then electrically removes the very small particles remaining in the gases. Thus, the bulk of the recovery is obtained with relatively low-cost equipment, and the final clean-up is obtained with equipment having unusually high recovery efficiency—approaching theoretically perfect, if desired.

The recovery of suspensions from gases is a highly exact science and every problem is different. Some require mechanical methods—others electrical methods—still others a combination of mechanical and electrical methods in proper balance to meet the individual requirements of each application. No matter what your problem, remember that only Western Precipitation has had years of field experience in BOTH mechanical and electrical methods!

Send for descriptive literature!

Let our experienced engineers study your recovery requirements and make an unbiased recommendation on the equipment best suited to your particular problem. A wire, phone call or letter to our nearest office places this unique "know-how" at your service, without obligation.

WESTERN Precipitation CORPORATION

DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1049 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
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PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

MULTICLONE—T.M. Reg.

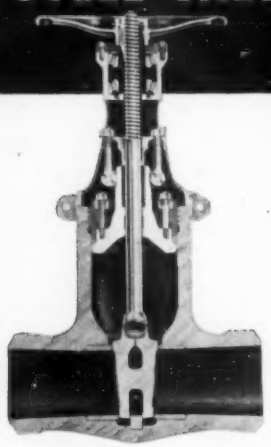
WALWORTH

PRESSURE-SEAL CAST STEEL VALVES

Better because ... **They have no bonnet flanges, bonnet bolts, or bonnet welds. Ideal for high-pressure, high-temperature steam service and corresponding boiler feed service, Walworth Pressure-Seal Cast Steel Valves weigh less, and take up less space than the flanged bonnet type of valves used for similar services.**

These are a few of the important advantages made possible by the design of Walworth *Pressure-Seal* Cast Steel Valves. Internal line pressure is utilized within the bonnet to maintain a tight, leakproof, body-to-bonnet connection under all normal operating conditions. The higher the pressure, the tighter the seal.

Ask for your copy of Walworth Circular 143. It gives detailed information, including sizes, dimensions, and specifications for all Walworth Pressure-Seal Cast Steel Valves.



Cross section of 8-inch Series 900 Walworth Pressure-Seal Cast Steel Gate Valve. Pressure-Seal Globe, Check, Angle, and Non-Return Valves are also available in Series 600, 900, 1500 and 2500 in a wide range of sizes.

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

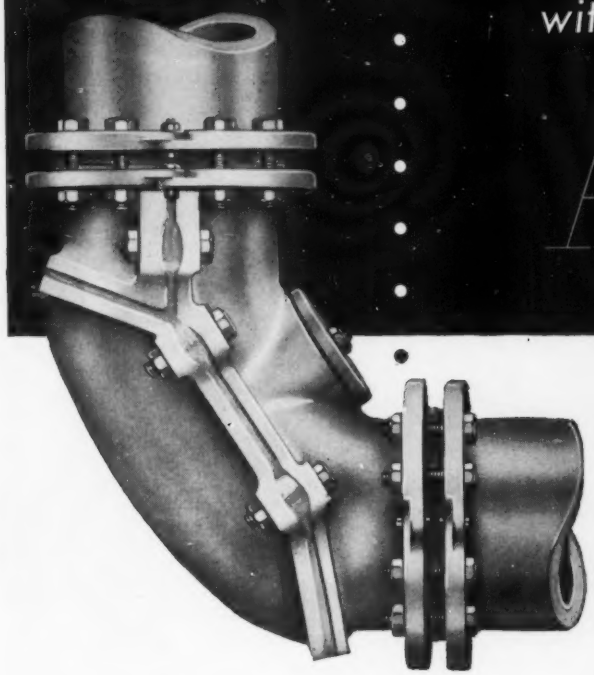
60 East 42nd Street, New York 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

CHICAGO FIRE BRICK BUILDS BETTER ASH CONVEYING SYSTEMS

with

ABK METAL



Chicago Fire Brick Company 4-piece elbow design made better with ABK Metal wear backs.

The Chicago Fire Brick Company, manufacturers of heat resistant ceramics and ash conveying systems, standardizes on ABK Metal parts where extreme abrasion is a major factor of wear.

Their experience in manufacturing and installing many power station ash handling and materials handling systems has proved that the ABK Metal parts give much longer service than ordinary "abrasion resistant" materials.

The confidence that Chicago Fire Brick places in ABK Metal castings is typical among those companies who use ABK castings to fight abrasion. Its service record is outstanding.

Benefit by the experience of others. Specify the exclusive nickel-chrome Brake Shoe castings with controlled matrix structure and hardness. ABK Metal will give you the extra service required for profitable operation.

QUALITY CASTINGS IN **ABK METAL MEEHANITE®**

AMERICAN **Brake Shoe** COMPANY

BRAKE SHOE AND CASTINGS DIVISION

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Houston St. Louis San Francisco Toledo

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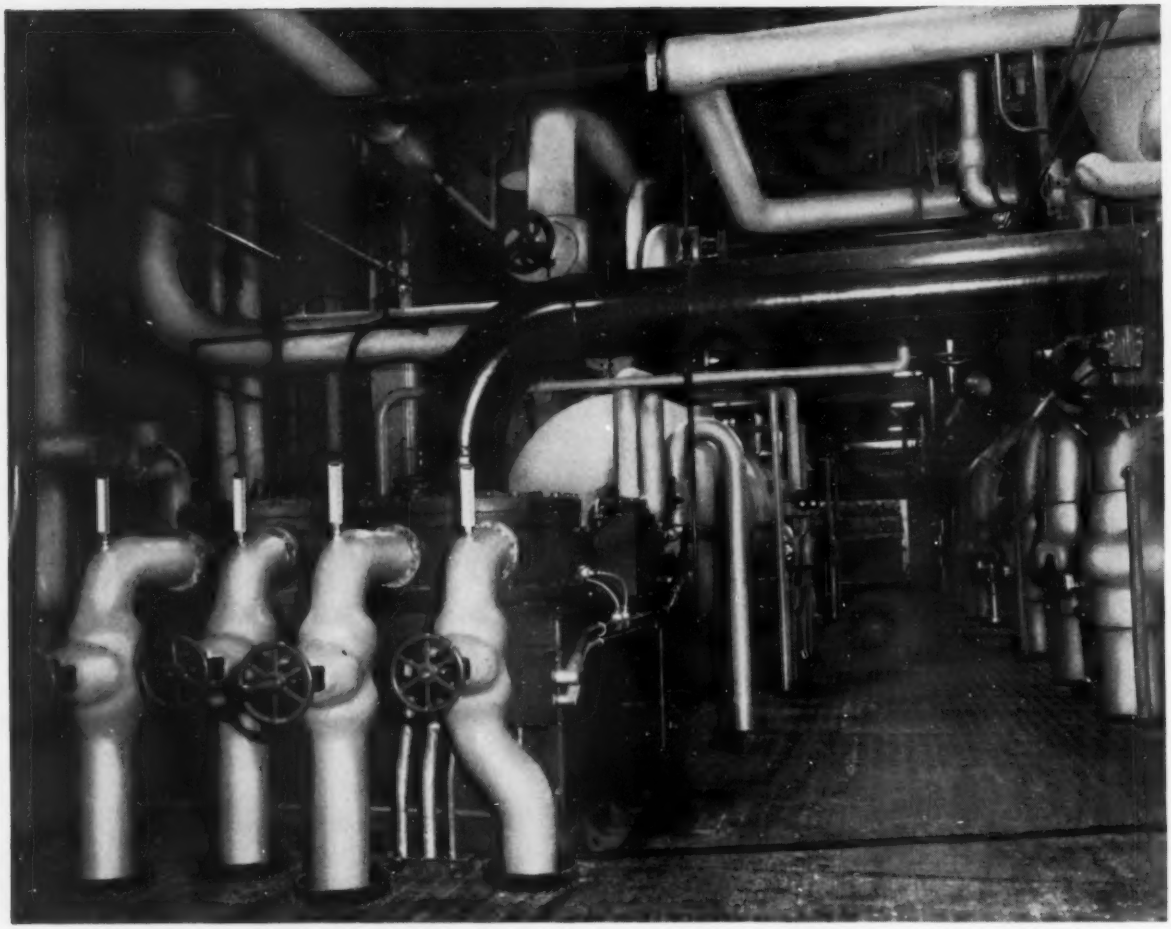


Main steam line and feeder equipment of a large southern power station insulated with a combination of K&M Hy-Temp and "Featherweight" 85% Magnesia.

Dollar and heat loss minimized by power stations with

K&M HIGH TEMPERATURE INSULATIONS

For efficient, money-saving conservation of heat, keep in mind dependable K&M High Temperature Insulations. For example, by itself, "Featherweight" 85% Magnesia (85% basic carbonate of magnesia and asbestos fiber) effectively insulates piping and equipment with temperatures up to 600° F. Used with a primary layer of K&M Hy-Temp Insulation (diatomaceous silica), the combination is effective on applications up to 1900° F.

These K&M insulations last the life of the equipment they serve. They withstand moisture, vibration and frequent temperature changes.

New and now available is "Featherweight" Water-Resistant Magnesia Insulation for temperatures up to 450° F. It is for use where severe water exposure may damage the insulation or on indoor lines and equipment where high humidity and moisture is necessary.

Your K&M distributor is an experienced applicator who will gladly give you more information on these heat-saving, money-saving K&M insulations. Or write directly to us.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

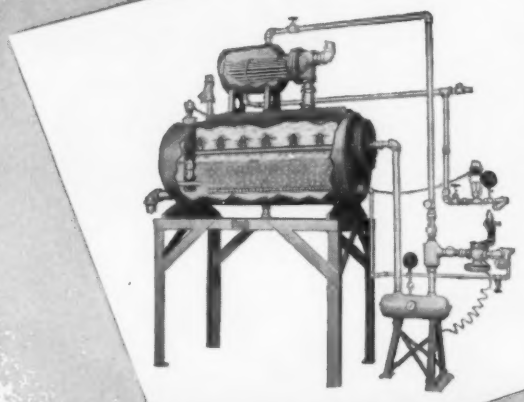
Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

In Canada: Atlas Asbestos Co., Ltd., Montreal, Toronto, Winnipeg, Vancouver

K&M best in asbestos ®

a Fresh approach . . . a Major advance . . .

in boiler feedwater deaeration



SCHAUB
ZERO-OXYGEN
Deaerators

NEW DESIGN! NEW PERFORMANCE! NEW SAVINGS!

Complete Oxygen Removal (to .005 cc/liter) • Complete Safety and Dependability • Wide Range for Load Variations • High Thermal Economy • Low Maintenance Costs • Simpler Design for Trouble-Free Service

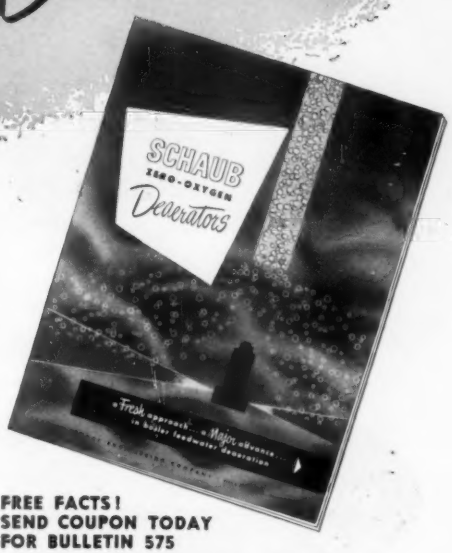
Start with an idea that's *basically* new and better. Then produce performance beyond the best that ordinary deaerators can deliver. Schaub engineers achieved it . . . developed the all-new deaerator that's a major advance in boiler feedwater deaeration!

Two basic differences give the Schaub Zero-Oxygen Deaerator its outstanding advantages . . . note them well. First, it provides *external* pre-heating to a temperature *above* boiling point, with over-atmospheric pressure held only up to the internal sprayer manifold! Second, a free, non-restricted vent liberates *all* air *immediately* with maximum vapor heat recovery!

From these simple fundamentals stems a whole series of all-important performance benefits. Every engineer or operating man concerned with boiler feedwater deaeration should have the full facts on all-new Schaub Zero-Oxygen Deaerators. Simply send the coupon to get the complete story — promptly.

FRED H. SCHAUB ENGINEERING COMPANY

2105 South Marshall Boulevard • Chicago 23, Illinois



FREE FACTS!
SEND COUPON TODAY
FOR BULLETIN 575

Tells why you need deaeration. Explains basic differences in deaeration systems. Here's the complete story on new Schaub Zero-Oxygen Deaerators.

FRED H. SCHAUB ENGINEERING COMPANY
2105 **South Marshall Boulevard, Chicago 23, Illinois**

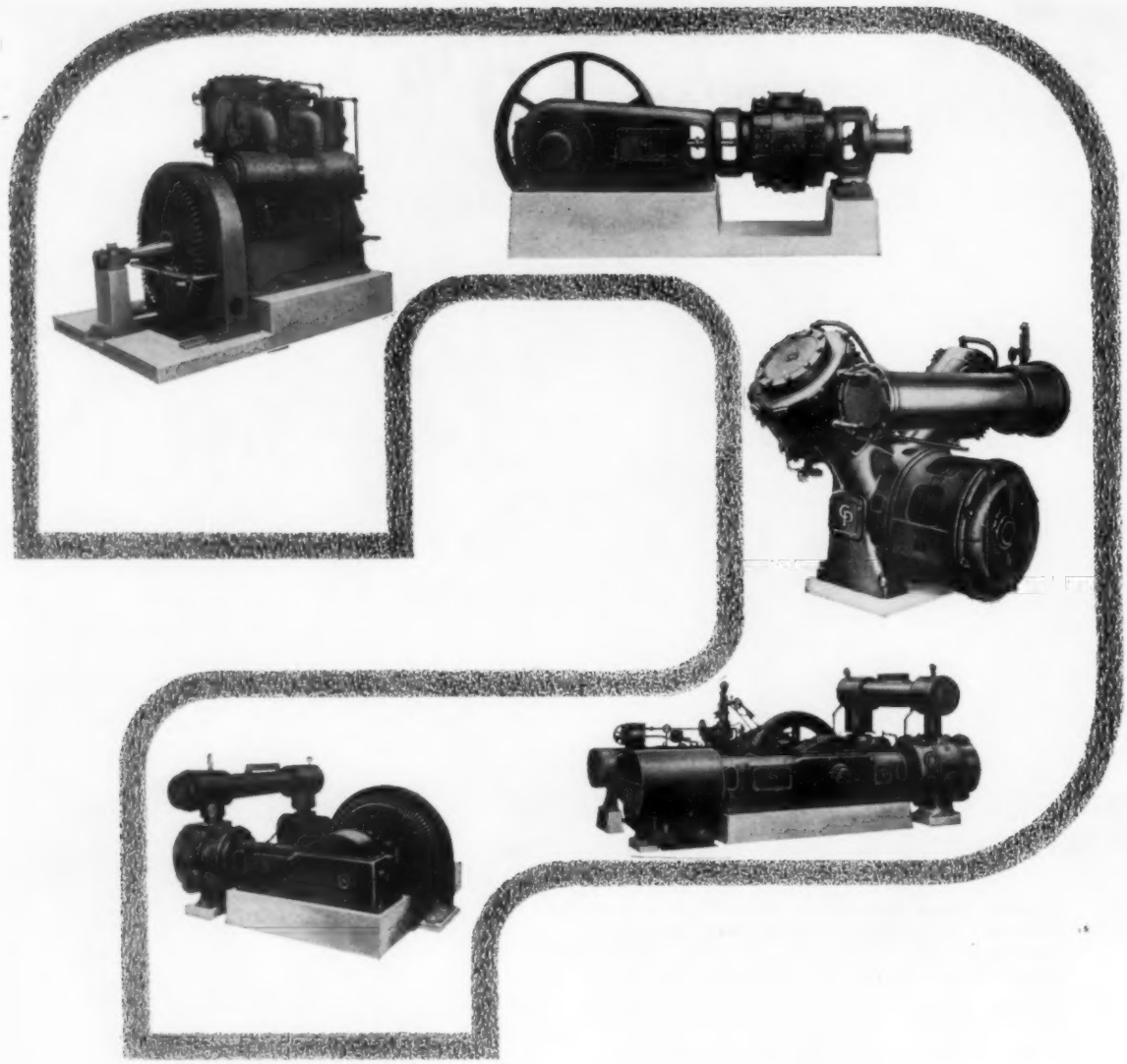
Please send me without cost or obligation, my personal copy of your new bulletin 575 on Boiler Feedwater Deaeration.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____



WHAT DO YOU WANT IN A COMPRESSOR?

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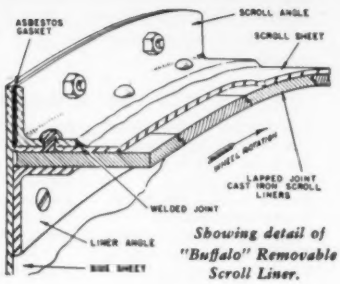

Showing detail of "Buffalo" Removable Scroll Liner.

Naturally, all other parts of "Buffalo" Draft Fans are built of equally durable construction — rotors, shafts, bearings and inlet boxes. And the number of "Buffalo" Fans still carrying on after more than a quarter of a century, is proof of this endurance which means economy. Why not check "Buffalo" engineering by writing today for Bulletin 3750?

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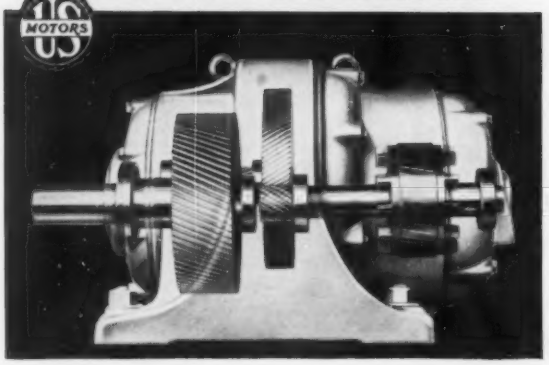

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DON'T go to the expense of installing a gear box with extra coupling and guards to rig up slow speed for a motor. Install the *U. S. Syncrogear motor* and avoid extra contraptions. You'll simplify your power hook-up, save space, eliminate hazards and give your driven machine the most efficient power. The U. S. Syncrogear motor was one of the first complete integral power units, introduced 22 years ago. It's backed by experience, tested and proved performance and engineering "know-how" that only U. S. MOTORS can offer to those seeking the most dependable geared motor power.

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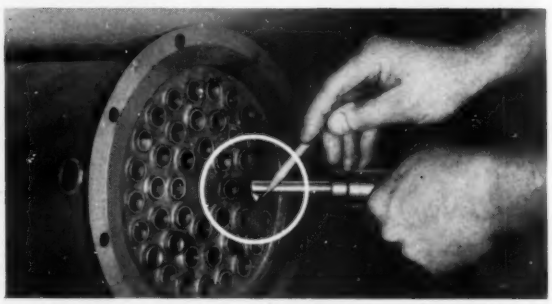

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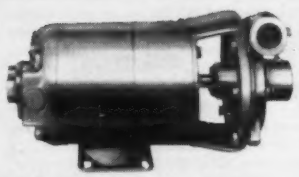
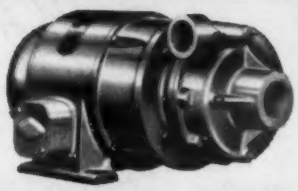
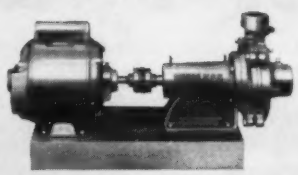


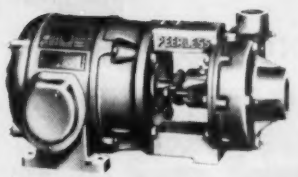
2, 3, 5 hp FACEMOUNT



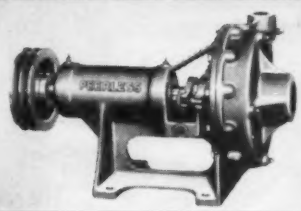
FLEXIBLE-COUPLED Fractional hp



5-50 hp DIRECT CONNECTED



FLEXIBLE-COUPLED Integral hp



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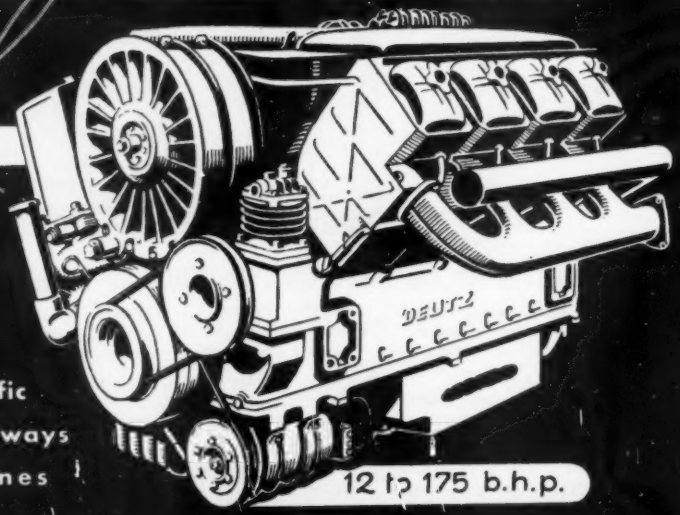

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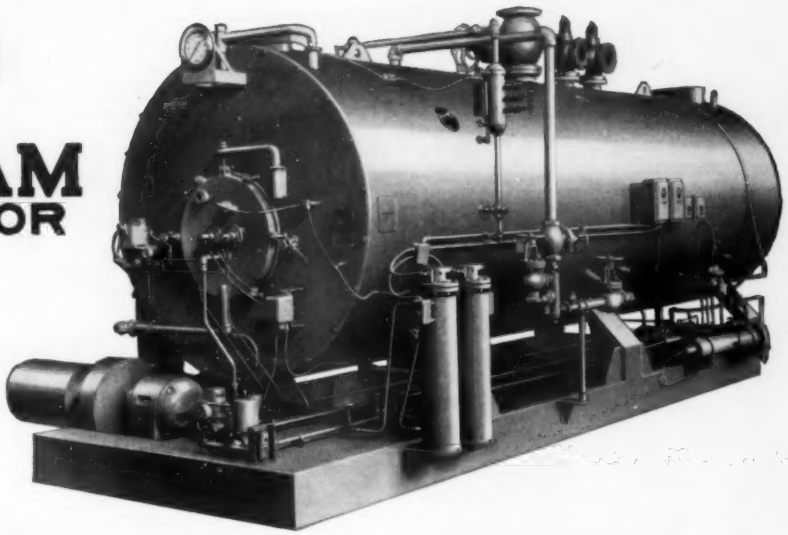

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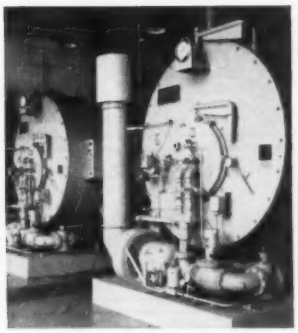

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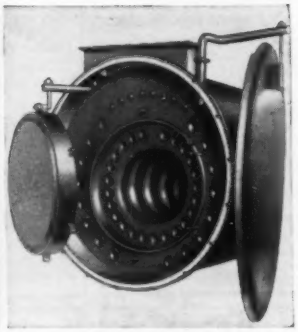

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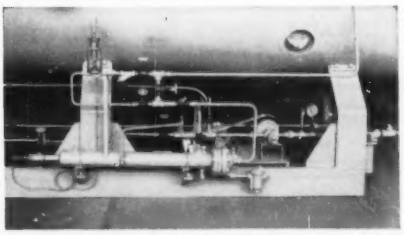
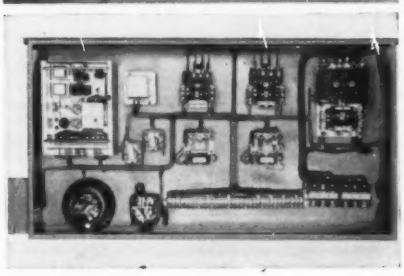


AMPLE ROOM

underneath for servicing auxiliary equipment. Control panel at eye level.



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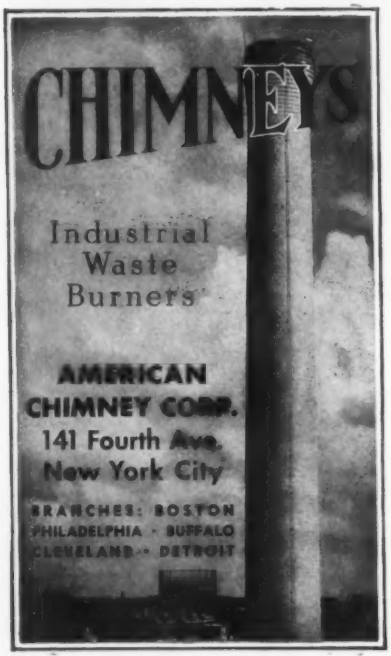

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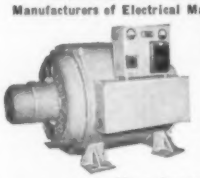

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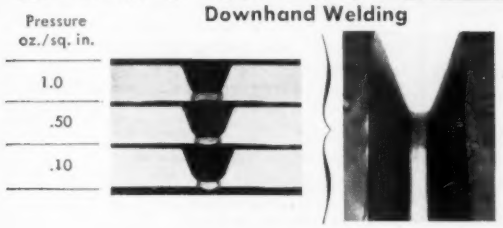

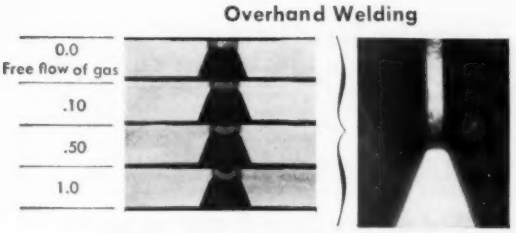

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Lists names, addresses, accounts served for over 2,000 sales agents, located in every state and throughout the world.

A valuable tool for every sales executive in the power-equipment market. Ten dollars per copy. Limited availability.

▼

Write to

POWER

330 WEST 42ND ST.
NEW YORK 36, N. Y.

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE

$1.50 a line. Minimum 3 lines. To figure advance payment count 5 average words as a line. (See ¶ on Box Numbers.)

POSITION WANTED undisplayed rate is one-half of above rate, payable in advance.

PROPOSALS, $1.50 cents a line an insertion.

INFORMATION

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NEW ADVERTISEMENTS, N. Y. Office, 330 W. 42nd St., N. Y., for the September issue closing August 6th

CHEMICAL ENGINEER WANTED

The Tennessee Valley Authority needs an experienced boiler feed-water control engineer for high-pressure, high-temperature steam plants in its Division of Power Operations located at Chattanooga, Tennessee. This is a staff engineering position. Salary range, $4735-$6575, depending upon training and experience. Applicants must have a college degree in Chemical Engineering or equivalent. Retirement benefits, annual and sick leave, 40-hour week.

Write to the

TENNESSEE VALLEY AUTHORITY

Division of Personnel

Knoxville or Chattanooga, Tenn.

WANTED

Power Plant Superintendent in Midwest Pulp and Paper Mill. College Degree necessary, 35 to 45 years of age with operating and supervisory experience preferred. Applicant must be capable of operating a power house with high pressure boilers, turbo-generators, water softening plant and related power house equipment. In first letter give complete resume of experience, age, education and required salary. Address replies to:

P-3276, POWER

520 N. Michigan Ave., Chicago 11, Ill.

OVER 2000 SALES AGENTS!

The new, 1954 edition of POWER's "Directory of Manufacturer's Agents Serving the Power Field" lists over 2,000 sales agencies, in every state and in virtually every country. Limited edition. Price $10.

POWER

330 W. 42nd St., New York 36

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

HELP WANTED—Male Assistant to Chief Mechanical Engineer of Engineering and Contracting Company doing Industrial Piping, Plumbing and Heating in Middle West. Desire estimating experience. Give experience, education, photo if available and salary expectations. P-3174, Power.

WE NEED These Men: Power Plant Maintenance Supervisor and Shift Operating Supervisor modern pulverized coal fired, high pressure Steam Generating Station. Excellent working conditions and employee benefits. Medium sized company, with good financial rating. Location—Southern Indiana. Write, giving complete information on educational and experience background, plus salary requirements. All replies will be held confidential. P-3353, Power.

MECHANICAL PLANT Betterment Engineer—Required by operating division of service organization, College graduate preferred, having five to ten years experience in operation and betterment of steam plants operated by public utilities. Location New York—some travel; Spanish desirable, but not necessary. Reply by letter giving age, education, experience, personal data, and minimum salary acceptable. P-3392, Power.

POSITIONS WANTED

WANTED POSITION as plant Supt. or chief engineer. M.E. experienced in the design, installation, operation and maintenance of steam, steam-electric, hydro-electric and industrial plants. Executive and Administrative experience and ability. Mature judgment based on 30 yrs. experience, young enough (50 yrs) for progressive thinking. PW-3322, Power.

STEAM POWER PLANT Superintendent with nine years experience operating oil and coal fired boilers and generating equipment. Technical education. Age 33. PW-2350, Power.

POWER PLANT Superintendent, with broad power and mechanical experience in supervision, construction, maintenance and operation. Prefer Mid-West or South utility, or industrial power plant position as Supt; Asst. Supt; or Chief Engr. Married, age 34, Technical education. PW-3298, Power.

DIESEL POWER plant operating engineer. 12 years experience. Also auxiliary steam plant experience. PW-3316, Power.

SELLING OPPORTUNITY WANTED

ACCOUNTS WANTED: Detroit Sales and distributor wishes to represent manufacturer on an exclusive basis. We distribute a line of plastic refractories to steel mills, power plants and forge shops. We have warehouse space available—TWX service and personnel to service your account. RA-3149, Power.

Don't forget the

BOX NUMBER

When answering the classified advertisements in this magazine don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

WANTED

WE BUY NEW & USED ELECTRICAL SURPLUS

Wire & Cable • Conduit Fittings
Wiring Devices • Switches
Electronic Components • Fuses
Motors • Transformers, Etc.

Phone—Rochester GLenwood 8840

DIAMOND ELECTRIC CO.
P. O. BOX 1632 • ROCHESTER 3, N. Y.

$ CASH MONEY $

WE BUY ELECTRIC SUPPLIES • MOTORS • TRANSFORMERS • WIRE • CABLE
SEND LISTINGS
ALLIED ELECTRIC COMPANY
Box 1838—1122 Falls Bldg., Memphis, Tennessee

At Your BUSINESS Service:

The Classified Advertising Sections (Searchlight Sections) of McGraw-Hill publications are at your service for the satisfying of almost every business need or want.

Because these publications are specialized in the field that they cover, your classified advertising of used or surplus new equipment, of securing a position or personnel, of offering or securing business opportunities will reach the right men, quickly and economically.

Classified Advertising Division

McGraw-Hill Publications, Inc.
330 W. 42nd St., New York 36, N. Y.

THANKS FOR THE APPLAUSE!

SATISFIED CUSTOMERS REPEAT ORDERS
HAVE BUILT THE VOLUME BUSINESS
WE DO SELLING

HEMPHILL *Guaranteed* EQUIPMENT

DIESEL GENERATOR SETS

3—75KVA C.W., 120/208 V., 3 Ph., 1200 RPM. V Belt. to KRUPP. 3C1/L., 2 cy. solid injection complete.

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
1	1000	G. E.	Auto	3	4150x2400
2	750	G. E.	HT	3	4150x120/240
2	750	G. E.	H	1	4600-120/240
1	500	Kuhl.	OISC	1	4150x2400
2	400	Fitts	OISC	1	4800/4150/2400 x240/480
3	333	Whse.	OISC	1	2400x575
1	333	G. E.	H	1	13200x220/440
2	300	G. E.	H	1	13200x440
4	200	G. E.	H	1	13200x440
1	200	G. E.	HT	3	2400x240
2	150	Fitts	ODSC	1	240x120/240
3	50	st. E.	H	1	4800x120/240
3	50	A. C.	H	1	230x120/240
1	25	G. E.	H	1	460x120/240

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	500	G. E.	1200	M	2400/4150
1	400	Whse.	450	CW	550
1	250	Whse.	600	CW	440
2	200	Whse.	600	CW	440
1	200	G. E.	600	MT	440
1	150	A. C.	1800	AY RW	2300
1	100	G. E.	1800	IM	220
1	100	G. E.	600	IM	440
1	75	G. E.	600	IM	440
3	60	G. E	1800	MT	220

DC, 230 VOLT MOTORS

Qu.	H.P.	Make	Speed	Type
1	300	G. E.	1200	MPC
2	150	C. W.	900	WP
1	125	G. E	1700	RC
2	75	C. W.	900	WP
1	30	C. W.	700	CM
1	35	G. E.	860	RC
1	25	Whse.	835	SK

WESTINGHOUSE M.G. SET

1000 KW, 600V D.C., 2400/4160V, 720 RPM, 3 Ph., 60 Cy., 7 PF Syn. Motor. Direct Connected Exciter, Motor Driven Rheostats, Switch Boards, all for full automatic operation.

SQUIRREL CAGE MOTORS

Qu.	Make	Speed	Type	Volts
150	G. E.	720	KT	440

125	G. E.	3560	KF	2300
100	G. E.	1200	FTR	220
75	Ideal	1200	AT	220/440
60	G. E.	1200	KT	220
50	G. E.	3560	FT	220
50	G. E.	600	KT	440
40	G. E.	3550	FT	440
30	G. E.	600	KT	440

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	G. E.	514	600	2300/4150 Syn
1	1000	Whse.	720	600	2300/4150 Syn
1	1000	Whse.	720	275	2300/4150 Syn
1	300	C. W.	1200	230	3-unit 2400/4150SR
1	300	G. E.	1200	230	2400/4150SR
1	200	Whse.	900	250	2300/4150 Syn
1	150	C. W.	1200	230	440 SC
1	150	3 Unit G. E.	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	C. W.	1200	125	2300 S.C.
1	100	G. E.	900	250	2300 Syn.
3	60	G. E.	1200	125	208 Syn.
2	30	G. E.	1200	125	440 SC

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
3	200	Whse.	720		4150
1	175	G. E.	720	ATI	2300
1	150	G. E.	720	ATI	2300
1	150	G. E.	1800	TS	220
1	150	Whse.	900	ISIG	220

OIL CIRCUIT BREAKERS

3—600 AMP. G. E. FKR-55-20, 15,000 V. 3 P. 100,000 KVA, SOLENOID OPER.

1—600 AMP. G. E. FK-143, 15,000 V. 3 P. 50,000 KVA, Manual with Disconnects, Metal Clad Enclosure.

• **THE HEMPHILL SEAL OF** *Satisfactory* **SERVICE**

JLHCo

THIS SEAL GUARANTEES INSPECTION BY HEMPHILL ELECTRICAL ENGINEERS

Member of The National Industrial Service Association, Inc.

"FOR POWER"
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 3-3737
PHONE NEW JERSEY—UNION 3-2600

FOR IMMEDIATE SALE

2—4000 K.W. TURBINE GENERATING PLANT

CONSISTING OF

TURBINES: C. A. Parsons Ltd., Single cylinder reaction, high pressure type condensing, 55 stages, 150 p.s.i. gauge, 200° F superheat, 3600 RPM. Governed to 10% overspeed and regulated no load to full load. Direct connected to:

ALTERNATORS: 4000 K.W., 5000 K.V.A., 2300 Volts, 60 Cycles, 3 Phase, 3600 R.P.M., with direct driven:

EXCITERS: 29 K.W., 125 Volts, 3600 RPM.

CONDENSERS: Worthington-Simpson high Vacuum low level jet type with extraction pump.

AUXILIARIES: Complete set of auxiliaries, including switchboards, circuit breakers. Bailey steam flow meters, water cooling towers and pumps, pipe and fittings, etc.

CONDITION: Purchased 1934—Used less than eighteen months—well maintained.

LOCATION: Inspection welcomed in Westmount, Que.

Apply:

GENERAL MANAGER, CITY HALL, WESTMOUNT, P.Q.

BOILERS

250 to 1000 H.P.
200 to 300 p.s.i.
1940 to 1948

All inquiries answered quickly and fully.

WARNER J. SHERB, INC.
342 Madison Avenue, New York, N.Y.
Telephone MUrray Hill 2-9098

200 & 150 HP 1200 RPM Slip Rg. Motors
D13000, D17000, UD24 Diesel Pwr. Units
938 & 1563 KVA Non-Cond. Turbo Units
527' Gardner Denver Air Compressor
500 HP 600 lb. Pressure WT Boiler
10 HP Lattner Oil Fired Boiler
300 HP 200 lb. Pressure WT Boiler
22"x42" Corliss Engine
H. & P., 6719 Etzel, St. Louis 14, Mo.

BREW WOLTMAN *Offers—*

Many years experience and service in POWER EQUIPMENT

—Specializing In

Turbo Units	**Steam Engine Units**	**Synchronous Condensers**
Diesels	**Rotary Converters**	**Synch. & Ind. Motors**
Boilers	**Motor Generator Sets**	**Oil & Air Circuit Breakers**
Transformers	**Frequency Changers**	**Feeder Voltage Regulators**

Your inquiries stating your needs will receive our careful and prompt attention

BREW, WOLTMAN & CO., INC., 50 Church St., New York 7

If there is
Anything you want . . .
that other readers of this paper can supply

or—

Something you don't want
that other readers can use, advertise it in the

SEARCHLIGHT SECTION

There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

America's largest source of New and Remanufactured Diesel Power

A.G. SCHOONMAKER CO., INC.

50 CHURCH ST., NEW YORK 7, N. Y.

PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA
TELEPHONE — DIGBY 9-4350 • TELETYPE — NY 1-2804
W. U. WIRE • CABLE — AGSCOMACH

PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1180	Worthington	SEH-8	1685	360
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
700	Worthington	EE-8	1000	327
600	General Motors	12-567	900	600
*500	General Motors	8-278A	750	720
*500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
*400	Ingersoll-Rand	S-8	600	720
*400	Sterling	VDS-8	600	1200
*350	Baldwin	VO-6	510	450
320	Superior	60-S-6	460	450
*320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
*160	Buckeye	80	240	600
150	Fairbanks Morse	338-17	225	300
*150	Worthington	CC-4	225	450
150	Ingersoll-Rand	S	255	600
100	General Motors	3-268A	150	1200
60	General Motors	6-71	90	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED
*—indicates NEW unit

ONE YEAR GUARANTEE!

DIESEL GENERATOR SETS

3—700 HP Winton (General Motors) 8 cylinder, 360 RPM, 485 KW Elec. Mchy. 3/60/2300 volt generators. Complete auxiliaries.

3—300 HP Buckeye 6 cyl. 600 RPM 4 cyl. 200 KW Ideal 3/60/480 Volts generators. Complete plant. New 1947.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

1—2000 KVA — 3-60-33000-4160Y Westinghouse type CPS Westinghouse self-contained substation.
1—450 KVA—3-60-13200-115/230 V. GE substation.
4—100 KVA—3-60-2400-208/120 V pyranol GE transformers with 225 A3 pole airbreaker mounted on case.
700 & 450 HP—180 rpm—4160 V UNUSED syn. motors.

H. BLAINE JOHNSON & ASSOCIATES
53 W. Jackson Blvd., Chicago 4, Ill.

M-G SETS!

1—500 KW, 240 V D.C., Whse. M-G Set, 900 RPM, Syn. Drive, 3/60/2200. Ser. 4979926 with magnetic reduced voltage starter.
1—200 KW, 125 V D.C., Type PED, Ser. 576881, E-M Set, 900 RPM, Syn. drive. 3/60/2300/4160.

TURBO-GENERATOR

1—750 KW, Elliott AC Generator, Frame 3232, 3600 RPM, 3/60/180. Elliott Turbine, inlet 200# ga. 112 deg. F. superheat. 28" hg. vac. exhaust. Complete with accessories.

SYNCHRONOUS CONDENSER

1—1000 KVA, Allis-Chalmers, 3 phase, 60 cycle, 2300 volts, 600 RPM

SYNCHRONOUS MOTORS

1—200 HP, F-M, 300 RPM, Type TZO, Frame 5
1—200 HP, E-M, 900 RPM, Type PED, 2300/4160V
1—150 HP, G.E., 277 RPM, Type ATI, 2300V

MOTORS

Amt.	HP	Speed	Make	Type	Frame
3	250	600	G.E.	KT568 (2200V.)	
1	150	1800	Whse.	CS(2200V.)	8718
1	150	1800	A-C	2200V.	
1	150	900	G.E.	I-K(2200V.)	15
1	125	1800	Whse.	CS	
1	100	1800	Whse.	CS	663C
1	100	1200	Whse.	CS	752C
1	100	900	G.E.	MT256 Slpr	
1	100	900	A-C	2300V.	

BENSON-WILIMZIG, INC.
1708 North 8th St. St. Louis 6, Missouri
Phone—GArfield 1-4290

BOILERS

12—304 HP Kewanee Firebox Boilers, Model 590, 125 PSI, with oil burners & soot blowers, ASME.

4—150 HP, HRT Boilers, 150 PSI, gas fired, ASME.

GENERATOR SET

1—300 KW, GMC 8-268A Diesel, portable, radiator cooled, 1200 RPM, 3/60/440.

PHONE — WIRE — WRITE

HEAT & POWER CO., INC.
70 Pine St., New York 5, N. Y.
HANOVER 2-4890

SAVE 50 TO 80% ON THE EQUIPMENT YOU NEED!

with CHICAGO ELECTRIC GUARANTEED "REBUILTS"

WIRE WRITE OR PHONE CAnal 6-2900

POWER EQUIPMENT FOR ALL INDUSTRIAL NEEDS

For over 43 years CHICAGO ELECTRIC has been of service to industry . . . furnishing modern electrical power equipment thoroughly rebuilt and fully guaranteed at substantial savings over new equipment. CHICAGO ELECTRIC'S modern plant houses one of the nations largest stocks of guaranteed rebuilt power equipment; ie

- AC & DC MOTORS
- GENERATORS
- M.G. SETS
- FREQUENCY CHANGERS
- ROTARY CONVERTERS
- VARI-VOLT DRIVES
- ENGINE GENERATORS
- TRANSFORMERS
- CONTROLS

plus a big selection of allied equipment such as HOISTS, CRANES, AIR COMPRESSORS, FANS, BLOWERS, REDUCERS, BOILERS and PUMPS . . . so, whatever you need and whenever you need it . . . be sure to check with CHICAGO ELECTRIC first!

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 volts or higher)

H.P.	Make	Type	Speed
1500	*Westg.	CS	1200
800	*Westg.	CS-1485	1800
700	*Westg.	CS	1200
500	*Al-Ch.	6316-8W	1800
500	G. E.	KT-424	450
400	G. E.	KF-550	3600
400	G. E.	KT-424	360
300	Al-Ch.	AN	1750
300	*G. E.	K-6344Y	1200
300	G. E.	K-6353 TEFC	720
250	*L.-Allis	OEX 148	720
250	G. E.	IK-17A	600
200	*G. E.	FT-540Y	3600
200	*G. E.	IK-13B	1800
200	*Al-Ch.	AN	720
200	Al-Ch.	ARWWT	585
200	*Westg.	CS	600
200	G. E.	IK-17	600
200	G. E.	K-6352	514
150	Al-Ch.	AR	3600
150	G. E.	IE-13A	1800
150	G. E.	IE 13B	1200
150	*Westg.	CS-812 S TEFC	1200
150	Westg.	CS-854	900

D. C. MOTORS 230 Volt

H.P.	Make	Type	Speed
250	Westg.	SK-201	650
250	Westg.	SK-220	450/600
250	G. E.	MPC-4	700
200	Cr. Wh.	CM	500
175	G. E.	ELC	750
100	G. E.	MPC	400/800
100	G. E.	RC-34	2500
100	G. E.	RC-19	575
100/150	G. E.	MCF	380/1000
50	G. E.	MCF	250/100
50	G. E.	RC-31B	1700
50	Cr. Wh.	CMC	700/1100
50	G. E.	DCC-204	650
35	Westg.	SK-150	350/100
30	Cr. Wh.	CCM-504	450
30/40	G. E.	CD-115	500/1500
25	Westg.	SK-1006	1100
25	G. E.	RC-32	800
25	A. C.	E-130	775

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts *(2300 volts, or higher)

H.P.	Make	Type	Speed
2000	*G. E.	MT-12	600
1500	*G. E.	MT-30	240
1250	*Westg.	CW	600
1000	*Westg.	CW	250
800	Al-Ch.	ANY	600
700	*Al-Ch.	ANY	720
600	*G. E.	MT-422	600
500	*Al-Ch.	ANY	600
500	Westg.	CW	350
400	Al-Ch.	3-brg.	450
400	*G. E.	MT-412	450
300	*G. E.	IE-15A	1800
300	*G. E.	MT-410	450
250	Westg.	HF-15H	600
200	*Westg.	CW	1200
200	G. E.	IK-15B	900
200	G. E.	IM	600
150	Cr. Wh.	50-R	1800
150	G. E.	MT-549	1800
150	Westg.	CW-772C	1200
125	G. E.	IM-15A	600
100	G. E.	IT-13A	1800
100	Al-Ch.	ANY	900
100	G. E.	IM	600
100	G. E.	IM	450

PUNCH PRESS MOTORS

NEW—3/60/220-440 Volt
High Torque—Hi Slip

H.P.	Make	Type	Speed
60/45	G. E.	KR-6325	1090/790
60	Westg.	CS-752-C	1060
60	Westg.	CS-857-C	1085
50	Westg.	CS-505	1080
50	Imperial	E-1584	1090
40	Reliance	AA-B-505	1635
40	Imperial	E-505	1080
40	Westg.	CS-505	1070
40	Westg.	CS-505	1090
30	L.-Allis	OK-445	1080
30	G. E.	KR-445	1065
25	Reliance	AA-C-504	1100
20	Imperial	E-405	1080
15	Imperial	F-444	1090

MOTOR-GENERATOR SETS

1000(3u)	Westg.	11000	137/275
500	Westg.	2300	137/275
500	Westg.	2300	275
450(3u)	G. E.	2300	125/250
400	A. C.	2300	120/240
300	G. E.	2300	250
200	G. E.	2300	250
200	Westg.	4160	250
200	Ridgeway	2300	250
170	G. E.	440	125
150	G. E.	2300	125/250
150	G. E.	4000	250
150	A. C.	2300	275
150	G. E.	440	275
100	Westg.	440	125
100	Elec. Mach.	440	125
100	Ridgeway	2200	275
100	G. E.	240	230
100	G. E.	440	125
90	G. E.	440	60
75	G. E.	440	125
60	Westg.	2300	125
60	A. C.	2300	125
50	Reliance	440	250
50	Westg.	240	125
40	G. E.	440	125
40	G. E.	440	250
35	Westg.	2300	150
30	G. E.	440	125
30	Westg.	2200	125
30	Cr.-Wh.	440	250
20	Bogue-GE	550	250
20	Bogue-G.E.	220/440	250
15	Westg.	220/440	250

SPECIAL
GEAR MOTORS

2—30 H.P. Westinghouse, Type CS-404, 3/60/220-440/TEFC, 1800 rpm with Falk Class 2-9.394 ratio reducer —190 rpm output.

CHICAGO *Electric Co.* 1320 WEST CERMAK ROAD, CHICAGO 8, ILL.

NEED AIR?
CALL
AMERICAN AIR OF JERSEY

AIR FOR SALE OR RENT
SINCE 1902
GAS • DIESEL • STEAM • ELECTRIC

NEW AND QUALITY REBUILTS

55 CFM Lindsay (GAS) Portable
60 CFM LeRoi—CPT—Worthington
80 CFM 6 x 5 Worthington HB—10 HP, Elec.
105 CFM Worthington—CPT—Portable
122 CFM 7 x 7 Worthington HB—20 HP Elec.
160 CFM Worthington—Portable
170 CFM Davey Semi-Portable 25 HP Elec.
210 CFM Worthington (GAS & DIESEL) Portable
211 CFM 9 x 9 Ingersoll, 40 HP Elec.
262 CFM 75 PSI—IR—ESI
270 CFM Sullivan—Buda Power Unit
284 CFM Worthington Semi-Portable, 50 HP Elec.
315 CFM Worthington (GAS or Diesel) Portable
379 CFM 40 PSI—CP-T
388 CFM Worthington Semi-Portable, 75 HP Electric
426 CFM 12 x 11 Ingersoll Rand ES, 75 HP Electric
500 CFM Worthington (DIESEL) Portable
600 CFM Worthington (DIESEL) Portable
622 CFM 14½ x 13 American AF 100 HP Electric
1085 CFM 35 PSI 20 x 12 Pennsylvania
1452 CFM 70 PSI 15/15 x 14 Pennsylvania Duplex
3582 CFM Ingersoll PRE-2, 600 HP Electric

AFTERCOOLERS

Adams—62 CFM—126 CFM—250 CFM—1200 CFM 1500 CFM

AIR RECEIVERS

18"x6'—24"x6'—30"x6'—30"x7'—36"x8'—42"x10'—48"x12'

American
AIR COMPRESSOR CORP.
DELL AVE. & 47th ST.
NORTH BERGEN, N.J.
Telephone, UNion 5-4848

MOTORS - GENERATORS
M-G SETS

Electrical Equipment of All Kinds

Rebuilt and Guaranteed LOWEST PRICES

LOW VOLTAGE MOTOR GENERATOR SETS

1—Hobart, 1000/500 amps, 6/12 volts
1—Chandy, 5000/2500 amps, 6/12 volts
1—Ridgeway, 4500 amps, 30 volts
1—Chandy, 3000/1500 amps, 24/48 volts
1—G.E., 600 amps, 30 volts

GEAR HEAD MOTORS

5—Link Belt, 20 HP, 74 RPM, TE
4—G.E., 40 HP, 561 RPM, TE
5—G.E., 60 HP, 427 RPM, TE

AC & DC MOTORS—PUMPS
AIR COMPRESSORS

LARGEST STOCK IN MIDWEST

BUCKEYE
Trading Corporation

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CHESTNUT 1-3110

FOR SALE
MODERN 1000 KW Turbo-Generator
in excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum. Textile, Pulp and Paper, and Sugar Refining Industries.

NEWMAN & COMPANY, INC.
6101 Tacony St. Philadelphia 24, Pa.

BOILERS

- 1—220 HP Heine Water Tube 160#
- 2—72 x 18 H. R. T. 150#
- 3—66 x 18 H. R. T. 125#
- 1—Kewanee HT-60 150#
- 1—125 HP Kewanee Firebox 125#
- 1—65 HP Leffel Scotch 125#
- 1—Kisco 60 HP Package—Late 125#

(ALL CODE BOILERS)

NELSON Machinery & Boiler Co.
GREEN BAY, WISCONSIN
Tel: 5-5383

2000 HP GE SYNCHRONOUS MOTOR

TYPE—TS-6426R, 3/60/6600, 300 RPM, .8 PF #5239778, Excellent Condition, Reasonable Price.

S. M. DAVIS
510 LaSalle St., St. Louis 4, Mo.

RE-NU-BILT
GUARANTEED

ELECTRIC POWER EQUIPMENT

D. C. MOTORS

Qu.	H.P.	Make	Type	Volts	RPM
1	2200	G. E.	MCF	600	400/500
1	2000	Whse.	Mill	600	230/460
1	1200	G. E.	MCF	600	750/950
1	940	Whse.	QM	250	140/170
1	900	Whse.		250	450/550
1	825	Whse.		250	95/190
1	600	Al. Ch.		250	400/800
1	500	Whse.	CC-216	600	300/900
1	500	G. E.	MCF	600	300/900
2	450	Whse.		550	415
1	400	G. E.	MCF	550	300/1050
1	200	Whse.	CB-511.3	250	400/800

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G. E.	MT-498	2300	360
1	1500	ABB		2300	720
1	1200	G. E.	MT	2300	275
2	1000	A. C.	Mill	2300	240
1	1000	G. E.	MT-452	2200	321
1	500	G. E.	M-574Y	6900	900
1	500	Whse.	CW	550	350
1	450	G. E.	IM	440	720
1	400	Whse.	CW-960A	440	1170
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	435
1	350	G. E.	MT-442 Y	2200/4000	253
1	350	G. E.	IM-17A	440/2200	720
1	250	G. E.	MT-424-Y	4000	257
1	250	G. E.	MT-559S	2200	1800
1	250	Al. Ch.		550	600

SQUIRREL CAGE

	650	G. E.	FT-559BY	440	3570
2	450	Whse.	CS-1420	2300/4150	354
	300	Whse.	CS	440	1170
	200	G. E.	IK-17	440	580
	200	G. E.	KT-557	440	1800
	150	Whse.	CS-8568	440	880
	150	Whse.	CS	440	580
	150/75	G. E.	IK	440	900/450
	125	Al. Ch.	ARW	2200	1750

SYNCHRONOUS

1	4350	C. W.	3501-SL	13800/6900	514
2	3500	G. E.	TS	2300	257
2	2100	G. E.	ATI	2300	360
2	1750	G. E.	ATI	2300	3600
2	2000	Whse.		2300	120
3	735	G. E.	ATI	2200/12000	600
1	720	G. E.	TS	2300/4600	720
1	500	Ideal	SM	2300/4160	1800
1	500	Whse.		440	900
1	450	Whse.		2200	128.5
1	450	Whse.		2200	450
1	400	G. E.	TS	2200	400

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	D.C. Volts	A.C. Volts
2	2000/2400	G. E.	450	250/300	2300/4600
2	2000	G. E.	450	600	2300/4600
1	2000	G. E.	500 25cg	660	11000
2	2000	G. E.	514	600	6600/13200
1	1500	G. E.	720	600	6600/13200
1	1500	C. W.	514	30/115	4000/13000
2	1000	Whse.	900	600	4160
3	1000	G. E.	720	600	2300/4600
1	1000	G. E.	900	260	6600
1	1000 (3U)	G. E.	900	250	2200
1	750	Whse.	900	275	4160
1	750	C. W.	514	30/115	2300
1	600	G. E.	720	250	440/2300

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	5000	Whse.	OISC	3	3300x2640
1	2500	Whse.	OISC	3	26400/13200x46
3	2000	G. E.	HVDDJ	1	66000/13800
1	1500	G. E.	HT	3	13200x220
3	1000	G. E.	HVDDJ	1	2400x480
6	1000	Wagner	OISC	1	13200x46

FREQUENCY CHANGER SETS

Qu.	KW	ake	Freq.	Voltages
1	12500	Whse.	60/25	13200/13200
1	3000	G. E.	60/25	2300/2300/4000
2	2500	G. E.	25/62.5	2300/2300
1	1000	G. E.	25/58.3	4400/2300
1	500	Al. Ch.	2560	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G. E.	Condensing 425—750 F. T. T. Surface Condenser 3/60/2300/4000 V Direct conn exciter.
1	1500	Whse.	Auto-extraction 190 lbs.—600° F.T.T. 60 lb. extraction 3/60/240 V. Div. conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P. 480/3/60.
1	750	G. E.	Condensing 265# I.S.P. 440V. 3 ph. 60 cy.—New—1944
1	750	Whse.	—Non-condensing 1 to I.S.P. 40# B.P. 750 Kw. 280 V. D.C.

BELYEA COMPANY, INC.
43 Howell St., Jersey City 6, N. J.

NOW IS THE TIME TO BUY....

"Certified Rebuilt" Motors and Generators

HIGHEST QUALITY . . . REDUCED PRICES

Check with WAGNER *First*

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn cond		4000/2300	900
625	Gen. Elec.	ATB	2300	450
600	Gen. Elec.	ATB	480	900
625	El. Machy.	Late	240/480	1200
485	Allis Ch.	1 brg.	480	400
350	El. Machy.	1 phase	480	1200
312	Gen. Elec.	ATB	240/480	600
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
150	Allis Ch.		240/480	1200
150	Gen. Elec.	ATB	2300	900
150	Whse.		2300/480	600
125	El. Machy.	Syn.	240/480	1800
125	Gen. Elec.	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
75	El. Machy.		2300	900
58	G. E.	ATB	240/480	1200
25	Whse. b.b.	1 phase	120/240	900
10	Kato b.b. New	3 phase	127/220	1800

LOW VOLTAGE M-G SET
Whse. 3636 amp. 20/55 V DC gen. w/synch. motor 220/440 V. 720 RPM and exciters.

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis. Ch. b.b.	EW	350	1200
250	Gen. Elec.	MPC	250	600
200	Gen. Elec.	RC	250	1150
150	Gen. Elec. b.b.	CDM	250	1500
105	Century b.b.	1500 amp.	70	1200
100	Allis Ch.	E	125	1200
100	Allis Ch.	E182	250	900
100	Delco b.b.	Mar.	125/250	1200
75	Cont. b.b.	D109X	125	1150
75	G. E. b.b.	CD	250	1050
75	F. M. b.b.	DH	125	1800
75	G. E. b.b. (2)	CDM135	125	750
75	Whse.	SK	250	900
75	Columbia b.b.		120/240	1450
60	Allis Ch.	E147	250	900
60	Whse. b.b. (2)	SK121	300	1200
50	Cr. Wh. b.b.	CCD	250	1800
50	Reliance	T	250	1150
40	Gen. Elec.	CD103	250	1500
40	F. Morse b.b.	DH	125	1800
40	Gen. Elec.	RC	600	1750
25	Whse.	SK93	125	1750
25	C. W. b.b. (2)	CCD	250	1200
20	Gen. Elec.	RC	125	1150

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
750	Whse.	Synch.	2200/4000	900
750	G. E.	Synch.	2200	514
600	E. M.	Synch.	480	1200
550	G. E.	Sq. Cage	2200	3600
500	G. E.	Sq. Cage	4000	1800
500	G. E.	Slipring	2200/440	450
500	G. E.	Synch.	440	900
450	Allis Ch.	Synch.	480	400
400	Whse.	Sq. Cage	2200	514
400	G. E.	Synch.	440	450
400	Allis Ch.	Sq. Cage	2200/440	1200
350	Whse.	Slipring	2200/440	600
350	Whse. (2)	Slipring	2300	450
300	El. Machy	Synch.	220/440	360
300	Al. Ch.	Sq. Cage	2200/440	720
300	Whse.	Synch.	2200/440	600
300	Al. Ch.	Slipring	2300	514
300	G.E.	Slipring	440	360
250	G.E.	Synch.	220/440	720
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L. A. (2)	Sq. Cage	2200	1800
225	G. E.	Synch.	220/440	900
200	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G. E.	Slipring	220/440	600
200	E. M.	Synch.	220/440	1200
200	G. E.	Slipring	220/440	360
200	Whse.	Sq. Cage	220/440	1800
200	E. M.	Synch.	220/440	514
200	Wagner	TEFC	2200	1200
175	G. E. (2)	Synch.	220/440	720
175	Whse.	Synch.	220/440	360
150	Whse.	Sq. Cage	220/440	900
150	G. E. TEFC	Sq. Cage	2200	3600
150	Allis Ch.	Slipring	2200/440	720
150	G. E.	Synch.	220/440	450
150	Allis Ch.	Slipring	2200/440	720
150	G. E. (2)	Sq. Cage	2200/440	720
150	G.E.	Slipring	220/440	450
150	Allis Ch.	Sq. Cage	2200/440	1200
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G. E. (2)	Slipring	220/440	600
125	G. E.	Slipring	220/440	450
125	F. M. (2)	Synch.	220/440	1800
125	Allis Ch.	Slipring	220/440	900
100	G. E.	Sq. Cage	220/440	600
100	Burke b.b.	Synch.	220/440	1800
100	Whse. b.b.	Sq. Cage	220/440	900
100	G. E. New	Slipring	220/440	1200
100	G. E.	Slipring	220/440	900

48 Years of Service to American Industry

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	350	1000
250	Gen. Elec.	LDR	250	450/850
200	Whse. dyna.	SK-151	250	1350/4000
200	G. E. (2)	RC59	230	850
150	Whse.	SK-201	230	300/900
100	G. E. dyna.	TLC-50	250	1050/4000
100	Allis Ch.	E182	230	600/1200
75	F. Morse b.b.	DH-140	115	1600
75	Whse.	SK170	230	635
75	Whse.	SK173	230	300/1200
50	Reliance	310T	230	850
50	Reliance b.b.	651T	230	750
50	Cr. Wh. b.b.	FH	230	1750
50	Whse.	SK185	230	300/900
40	Whse.	SK143	230	600/1500
40	Reliance	651T	230	350/1000
40	Allis Ch.	E-121	230	1750
40	Gen. Elec. (2)	CD103	230	1150
40	Gen. Elec.	RC32	550	1200
40	F. Morse b.b.	DH 120	115	1750
30	Imperial b.b.	D69	230	400/1600
30	Star b.b. (3)	SB	230	1750
25	Star b.b.	SB	230	1750
25	L. A. TEFC	RNA	230	850
25	Whse.	SK150	230	380/1200
25	Gen. Elec.	CD105	230	575/1720
25	Whse.	SK100L	230	1150
20	Century b.b.	DN326	230	3500
20	G. E. series	CO-1826	230	875

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
1000	G.E.*	6600 AC	600 DC
500	Whse.*	2300-AC	250 DC
300	G. E.*	440 AC	250 DC
300	G. E. (2)	2200/440 AC	125/250 DC
250	Allis Ch.	2200/440 AC	250 DC
200	Whse.* (2)	220/440 AC	55 DC
200	G.E.*	220/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Whse.	2200/440 AC	275 DC
105	Century b.b.	220/440 AC	70 DC
100	G. E.*	2200/440 AC	125 DC
100	Allis Ch.	220/440 AC	250 DC
100	Delco b.b.	220/440 AC	125/250 DC
80	Star* b.b.	220/440 AC	240 DC
60	Gen. Elec.*	220/440 AC	60 DC
60	Whse. (2)	220/440 AC	200 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Cr. Wh. b.b. (3)	220/440 AC	240 DC
40	G. E. (2)	220/440 AC	250 DC
40	Gen. Elec.	220/440 AC	600 DC
25	Whse.	220/440 AC	125 DC
25	Gen. Elec.	220/440 AC	250 DC
20	Star b.b.	220/440 AC	120 DC
16	Gen. Elec.	220/440 AC	125 DC
15	El. Prod.	220/440 AC	40 DC
15	Star b.b.	220/440 AC	250 DC

10,000 other items in Stock.
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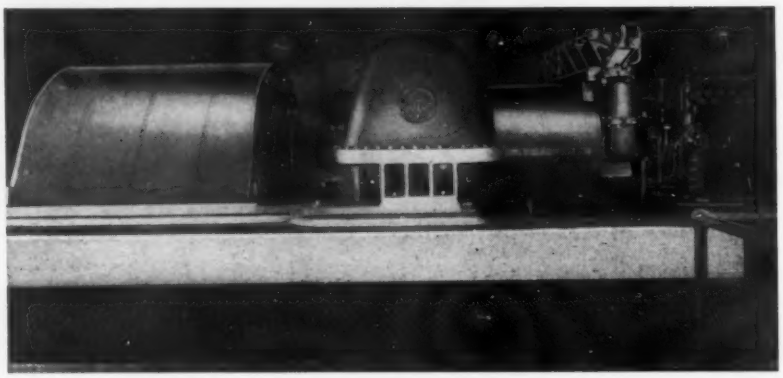
ARTHUR WAGNER COMPANY
1435 W. RANDOLPH ST.
CHICAGO 7, ILLINOIS
TELEPHONE MONROE 6-7409

3750 KVA. - G. E., 400#, 750° F.T.T. TURBINE-GENERATOR



Above view was made from a recently taken photograph of the 3750-KVA, G.E., Turbine. It is a condensing machine complete with 2-pass, 6000 sq. ft. Surface condenser, Switchboard with instruments, D.C. Exciter. Voltage is 3/60/2300-4160. Steam, 400# psig.

MACHINE CAN BE INSPECTED IN OPERATION

We own and offer any Condensing Turbine from 300-KW to 12,500-KW. A complete line of good Boilers, also a full stock of non-condensing Turbines and Diesel Engines. Send us your specs.

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CHARLES WEAVER
4145 PENOBSCOT BUILDING
DETROIT 26, MICHIGAN

TELEPHONE: WO. 1-1340

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BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.
Custom-built transformers and coils manufactured to your specifications.
Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned.

Ask for our price schedule

THE ELECTRIC SERVICE CO., INC.
5331 Hetzel St. Cincinnati 27, Ohio

40 Years' Dependable Service

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

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625 KVA AMES UNAFLOW

4 Cyl. Vertical, 14 x 16, 300 RPM #47899 WEST. 3/60/2300, .8 PF, Dir Con. Ex.

Excellent Condition Very Low Price

S. M. DAVIS
510 LaSalle St., St. Louis 4, Mo.

DIESEL GENERATOR SETS

200 KW General Motors Model 8-268A, 8 Cyl., 3/60/440 volts, 1200 RPM. Inc. Switchboard & Accessories.

100 KW G.M. Model 3-268A, 3 Cyl., 2 Cy., 3/60/440 V., 1200 RPM. Panel. Overhauled. Other sizes in stock.

ALJON ELECTRIC DIESEL CO.
904 Pacific St. Brooklyn 38, N. Y.
STerling 3-6515

FOR SALE

2 American Marsh Steam Vacuum Pumps—Size 25" x 16" x 20"—In Perfect Condition. Price: $800.00 ea., F.O.B. Washington, D.C.

S. E. DOCKSTADER, INC.
1025 Brentwood Rd., N.E., Wash'tn 18, D.C.

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10 SPECIALS

1563 KVA 3/60/480 v. GE. TURBO unit "bleeder"
1650 KVA and 937 KVA Wghse TURBO Units; non-condensing
625 KVA Al Chal TURBO unit, non-cond. 3/60/480/240 v.
250 KVA (2) Wghse 3/60/480/240 v—7 cyl. DIESEL units
187 KVA GE 3/60/440/220 v—Skinner UNI-FLOW unit
125 KVA GE 3/60/440/220 v—Sterling GASOLINE unit
500 HP (3) B&W 160# low head BOILERS
300 HP (2) Keeler 250# PACKAGE BOILERS
300 (2) B&W 160# low head BOILERS
250 HP (2) B&W 225# low head BOILERS

POWER PLANT EQUIPMENT CO.
39 CORTLANDT STREET NEW YORK, N. Y.

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O'Brien Offers—

MOTOR GENERATOR SETS

1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW Ridgway 250 V. 3/60/2300/1200 rpm
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
2—180 KW G.E. Frequency Changers 60/120 cycle
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
1—100 KW G.E. RC 17, 125 v. 3/60/220/1200 rpm
1—100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW West SK Comp'd 125 V., 150 HP West syn. 3/60/440/1200 rpm.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph. any voltage.
2—70 KW Century, 1000 amp, 70 volt, 3/60/220/440
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW GE 500 Volt DC, 75 HP, 3/60/40/1200 RPM.
1—18 KW Optimus, 3000/1500 amp 6/12 volt
1—17 KW West., 28 v. 60 amp 3/60/220
1—6 KW G.E. 6 v. 100 amp, 3/60/220

DIESEL GENERATOR SETS

2—800 KVA ALCO-Sulzer, 240 D.C. or 3/60 any voltage, 720 rpm
3—625 KVA Ingersoll Rand, 3/60/480/720 rpm
375 KVA GM 8-268 Diesel 3/60/440
300 KW GM 8-268 Diesel 125/250 V. D.C.
187 KVA GM Twin Diesel 3/60/220 New
125 KVA Waukesha Diesel 3/60/220-440
100 KW Buda Diesel 250 V. D.C.
100 KVA Murphy Diesel 3/60/220-440
65 KVA Buffalo Gas 3/60/220
56 KVA Climax Gas 3/60/220
45 KVA Chrysler Diesel 3/60/220
30 KVA LeRoi Gas 3/60/220
25 KVA LeRoi Gas 1/60/120/240
20 KW Hercules Gas 110 volt D.C.
18.75 KVA Hercules Diesel 1/60/120/240

BOILERS

1—25000# Foster Wheeler 250 Lb. W. T. Package Oil & Gas Comb. New
1—50,000# Erie Stoker New 160 psi
1—300 HP Keeler CP 300 lb. Oil
1—250 HP Ames Package type (1948) 150 psi oil fired
1—250 HP B & W 250 lb. 1948
2—200 HP Springfield Sec. Hdr. 400 psi.
1— 25 HP Dowtherm Vaporizer

ELECTRIC MOTORS

QU.	HP	Make	Type	Volts	Speed
1	1500	Al. Ch.	sl. rg.	2300	514
1	1000	G.E.	K	2300	1800
1	1000	West.	CW	2300	450
1	700	West.	CS	2300	1800
1	500	Al. Ch.	Syn.	2300	212
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
3	3500	G.E.	IM	2300	120
1	350	G.E.	MT18	2300	400
2	200	G.E.	KT559	2200	1200
1	200	West.	CW	440	1800
1	200	G.E.	IM	440	600
1	125	West.	Syn. 3 brg.	550	600
2	100	G.E.	KT352	220/440	1200

TURBO GENERATORS

1—2500 KVA West. Cond. New 1936. 3/60/2400—200 psi Surf. Cond.
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 p.i 5 lb. B.P.
1—50 KVA 1200 rpm Century generator (New 1949) Dean Hill Non-condensing turbine
1—75 KW G.E. Non-Cond. D.C. 125 volt.

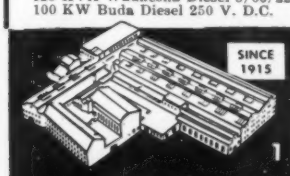
AIR COMPRESSORS

1—1600 cfm IR PRE-2 Syn. Mtr. Dr. 3/60/2300—100 psi.
2—1300 cfm IR-PRE-2 3/60/2300—100 psi
1—1000 CFM Chicago OCE Syn. Mtr. Dr. 175 HP 3/60/2300.
1—978 CFM Sullivan 13x13x8, 45 psi.
1—670 CFM Chicago OCE Syn Mtr. Dr. 3/60/2300
2—660 cfm I R-XRE 3/60/480—100 psi
1—396 CFM Sullivan WL60 125 psi Direct Drive 75 HP 3/60/440
1—215 CFM Penna 3A, 70 psi—V-Belt
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—371 CFM Schramm 7¼x5x4, 100 psi
1—173 CFM Chicago NSB 100 psi

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	2000	G.E.	13200	230/460	1
3	1000	GE	13200	2300	1
1	1100	West.	4160	440	3
1	750	O'Brien (New)	13200	480	3
3	667	Al. Ch.	33000	2300	1
3	500	West. Dry	33000	2300	1
3	500	West.	22000	460	1
1	500	Gregory	4160	440	3
3	500	GE	13200	2300	1
3	400	GE	2400	480	1
3	333	West. Dry	2400	480	1
3	333	West. (1945)	33,000	480	1
3	333	Pitts.	33000	2300	1
3	333	G.E.	13800	240/480	1
3	250	Al. Ch.	13,200	115/230	1
2	250	West. Dry	13800	230	1
3	150	West	2300	230/115	1
3	150	Dry	2300/4160	230/460	1
3	100	Dry	2300/4160	230/460	1
3	100	West.	4160	240/480	1
3	85	West.	4160	120/240	1

"Everything from a Pulley to a Powerhouse"



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COMPLETE POWER PLANT

4—1285 HP B. & W. Boilers, rated 225# psig steam, A.M.S.E. code, lower tubes retubed in 1952, C/W underfed stokers, boiler feed pumps, blowers, Cochrane Heater, pipes & valves, etc.

1—15,000 KVA G. E. Turbo-Gen. Set, type ATB-4, 3 ph., 60 cy., V 9000, 1800 RPM, direct connected to a Curtis Condensing Turbine, 200# psig steam, C/W 20,000 sq. ft. C & H Wheeler Surface Condenser, Condensate Pump, Switchboard, etc.

1—50 ton Whiting Power House Overhead Crane with 10 ton aux. hoist, 45' span, 3/440/60, operator cab.

Location—New York State. Price and further information on request.

PHILA. TRANSFORMER CO.

2829 Cedar St. Phila., Pa.

1000 KW GE M-G SET

1400 HP, TS-C, 3/60/6600-13200, 900 RPM, .7 PF MCF-H-6, Cpd. Wd. 600 V., 1667 Amps. STEEL FRAME MACHINES & BASE. Complete Auto. AC & DC Controls On Orig. Foundation.

Excellent Condition Very Low Price

S. M. DAVIS

510 LaSalle St., St. Louis 4, Mo.

SPECIAL BARGAIN OFFERINGS

DIESEL GENERATOR UNITS COMPLETE INSTALLATIONS

592 KVA—473 KW, 80% P.F., Fairbanks Morse generator, 3 phase, 60 cycle, 2400 volts direct connected to a:

690 HP, Fairbanks Morse Diesel engine, 300 RPM, Model 33E14, 6 cylinders, 14" bore, 17" stroke. NEW 1949.

429 KVA—343 KW, 80% P.F., Fairbanks Morse generator 3 phase, 60 cycle, 2400 volts direct connected to a:

500 HP, Fairbanks Morse Diesel engine, 400 RPM, Model 33F12, 5 cylinders, 12" bore, 15" stroke. NEW 1948.

250 KVA—200 KW, 80% P.F. Electric Machinery Manufacturing Company generator, 3 phase, 60 cycle, 2400 volts direct connected to a:

300 HP Buckeye Diesel engine, 450 RPM, enclosed type, 7 cylinders, 10" bore, 12" stroke. NEW 1940.

111 KVA (2)—88½ KW, 80% P.F. Fairbanks Morse generators, 3 phase 60 cycle, 2400 volts each direct connected to a:

140 HP Fairbanks Morse Diesel engine, 300 RPM, Model 32D, 2 cylinders.

UTILITIES MACHINERY CORPORATION

1965 EAST 6th ST. • CLEVELAND 14, OHIO • CH-1-4070

FOR SALE by The City of Chicago

UNIT 1

• 1—250-KVA Steam Turbine Driven Allis-Chalmers Generator 4000 V—36 Amp. 3 ph.—60 cycle 3600 RPM Driven by Kerr turbine. Installed in 1916.

UNIT 2 and 3

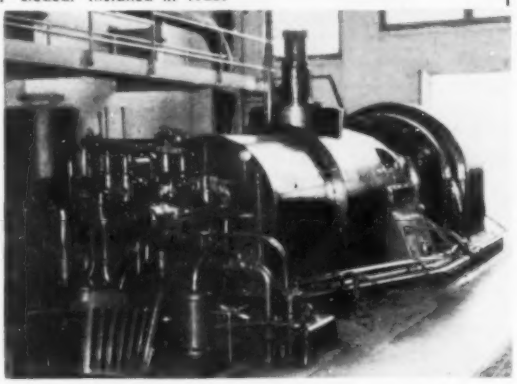
• 2—625 KVA Steam Turbine Allis-Chalmers Generators 4000 V —90 Amp. 3 ph.—60 cycle—3600 RPM—Driven by Kerr turbine. Installed in 1916.

UNIT 5

• 4—Hartzell Motor Driven Fans for Cooling Tower Fans—4 blades 8'4" dia. Cap. 74,000 CFM each against 0.50" H_2O—Motors—Westinghouse—weatherproof—15 hp—490 RPM—3 ph. 50 cycle. 220 V. Installed in 1934.

UNIT 4

• 1—1875 KVA Steam Turbine Allis-Chalmers Generator 4000 V—271 Amp. 3 ph.—60 cycle—3600 RPM—Driven by Allis-Chalmers turbine—one new spare turbine rotor included. Installed in 1935.



All of the above units include condensers, exciters, condensate pumps, switchboard panels, c. o. relays, and electric meters.

Generators on Units 1, 2, and 3 are in good condition. Turbines on Units 1, 2, and 3 are operable. Steam guarantee of the old units based on 190# gauge—0°F superheat—27½" vacuum.

Kw Load	*Lbs/Kw hr.*
750	15.5
1125	15.68
1500	15.88

The amount of steam possible to bleed at the 20 pounds absolute is 35 to 40,000 lbs./hr. (Present market price on No. 4 Unit approximately $85,000.00 excluding labor for erection).

Successful Bidder must furnish labor and equipment to dismantle and remove according to conditions as specified in the "Bid Form."

The above equipment will be sold on a sealed bid basis at 11:00 A.M. Monday, August 30, 1954. Bids will be opened in Room 400, City Hall on the above date. "Bid Forms" may be obtained by writing Mr. Jas. Regan, Chief Storekeeper, Room 400, City Hall. Please ask for Proposal No. 72-54—.58.

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MUNICIPAL POWER PLANT

2805 S. Sacramento Ave., Gate 7, Chicago, Illinois

GENERAL ELECTRIC 1000 KW TURBO-GENERATOR

GENERATOR

1250 KVA—3600 RPM 60 Cycle, 2300 Volts .8 PF, 314 Amps

TURBINE

140# 3600 RPM 3 stage With Jet condenser and all auxiliaries.

LANSDALE MUNICIPAL ELECTRIC DEPT.

421 WEST MAIN STREET — LANSDALE, PENNA.

ELECTRICAL FUSES

Any Amperage • Any Voltage

We carry on hand the largest surplus stock of electrical fuses in the world. Over 50,000,000 in stock. We guarantee a minimum savings of at least 20%. We invite your inquiries. Specials are our specialty.

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2000 KW GE RECTIFIER

Mercury Arc Pump Type NEW in 1949. 3/35/13,000 to 630 V. DC, with all access. Excellent Condition. Priced Very Low. OK for 60 Cycles.

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WANTED G.E. Watthour Meters

FOR SALE Large quantities Watthour Meters and WHR Demand Meters

TYPE MG2S, 15 A. 120/208 3 Wire 60 Cy. Network
TYPE CAH 5 & 50 A. 120/240 3 Wire 60 Cy. 1 Phase
TYPE CAH2, 5, 15, 50A, 240 3 Wire 60 Cy. 3 Phase
100 Phase Trans. Delta 3 phase 4 Wire 240/240
G.E. MCT.
1000 Dem. Regs. G.E. Type M21P Univ Rat. 15 min.

THE ELECTRICAL WATTHOUR METER CO.

76-15 Woodside Ave., Elmhurst 73 N Y. HA 9-0131

Your Portable Generator Headquarters

- DIESEL - **- GASOLINE -**

1 to 1000 KW, AC & DC

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FOR SALE

One second hand Strong Scott Coal Pulverizer 1946 Model. Capable of burning 1700 lbs. coal per hour. Unit includes 20 H.P. 550volt 3 phase 60 cycle induction motor which drives both fan and pulverizer. Contact **COATS & CLARK INC.**, Toccoa, Georgia.

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2—300 HP VAN SEVERIN Direct Connected to 250 K.V.A. 3 Ph. 60 Cy. 240 V Ideal Generators. Late Type.

1—300 HP VAN SEVERIN—same as above w/179 K.V.A. Generator. Complete with Switch Gear.

4—650 HP STERLING Viking Diesels, Model VDS-8, 1200 R.P.M. Like New.

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JOSEPH BEHR & SONS, INC.
1246 Seminary Street, Rockford, Illinois
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36" bronze Chapman valves—30 pound pressure.

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Curtis 7-5050

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2—202 H.P. 250 Lb. Scotch Marine Type External Dutch Oven Fired Walsh-Widener Boilers

Cyclotherm 50 H.P. 125 Lb. Heavy Oil

Cyclotherm 100 H.P. 125 Lb. Heavy Oil

750 Deg.—1,600,000 B.T.U.—125 Lb. International-Dowtherm Boiler

2—25 H.P. Ames Package Boilers 1949-1951—Gas or Light Oil—100 Lb.
50 H.P.—150 Lb. Steamaster

BOILER & EQUIPMENT CO.
743 Bedford Ave. Brooklyn 5, N. Y.
ULster 5-3588

3333 KVA TRANSFORMERS

3—GE, WC-HDH, 13,200/60/1 x 2300-4000Y
4—Al-Ch Ditto Water Cooled, Steel Cases. Excellent condition. Priced at 50c KVA.

S. M. DAVIS
510 LaSalle St., St. Louis 4, Mo.

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1—Kennedy Van Saun 3' D x 6' L Contin. Steel Lined Ball Tube Mill.
1—Allis-Chalmers 6' D x 16' L Contin. Steel Lined Ball Mill

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SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
600	440	Whse.	1800
600	2200	Whse.	450
500	2200/4000	G. E.	900
450	440	Whse.	514
450	440	Whse.	720
400	440	G. E.	900
300	4000/2300	Whse. (new)	600
300	2200/440	G. E.	720
300	440	G. E. (hoist)	600
300	2200	G. E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	550/440	G. E.	1200
250	440	G. E.	600
200	440/220	Whse.	514
200	440	G. E.	450
150 (2)	440/220	G. E.	720
150	2200/440	G. E.	600
150	550/220	G. E.	720
145	4000/2300	G. E.	1800
135	440/220	G. E. (hoist)	600
125	440/220	G. E.	900
125	550/440	G. E.	1200
125	2200	G. E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G. E.	ATI	720
375	440/220	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G. E.	TS	720
300	2200/440	G. E.	TS	1200
250	2200/440	G. E.	TS	720
250	440/220	G. E.	ATI	1200
250	2300	G. E.	TS	3600
250	440/220	Whse.	HR	277
250	2200/440	G. E.	TS	1200
250	440/220	G. E.	ATI	600
200	4150/2300	Whse.	G	1800
125	440/220	Whse.	HR	400
110 4	40/220	G. E.	TS	257

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G. E.	FT	3600
500	2200	Whse.	CS	514
500	2200/4000	Elliot	SC	1800
500	2200	G. E.		450
400	2200	G. E.		360
400	2200/400	Whse.	CS	720
300	2200	L. Allis	FS	1800
250	2200/440	G. E.	IK	720
225 (2)	2200/440	G. E.	KT	1200
200	2200/440	G. E.	K	1200
200	440	G. E.	IK	720
200	440/220	G. E.	KT	1800
200	2200/440	G. E.	JK	600
200	2200	G. E.	KT	1800
150	440/220	Whse.	CS	900
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440	Multi sp.	KT	1800/600
150	440/220	G. E.	IK	450
150	440/220	G. E.	KT	720
150	440/2200	G. E.	IK	514
150	2200/440	G. E.	KT	600
125	440/220	G. E.	KT (vert.)	1200
100	2200/440	G. E.	K	1200
100	220/440	G. E.	K-TEFC	720
60 (2)	2200	Whse.	CS X-pf.	1800
50 (2)	410/220	Whse.	CS-TEFC	1800
50	220	Al. Chal.	X-prf.	600/1200

A. C. GENERATORS

1—320 kva. 660 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 480/220 V., G. E.
1—250 kva, 720 rpm, 2300/440 V., G. E.
1—225 kva, 600 rpm, 220/440 V., G. E.
1—200 kva, 720 rpm, 2200/440 V., G. E. (Ball brg.)
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V., G. E., Sol. opr., draw-out

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
225	230	Whse.	SK	2870
200	230	G. E.	CD	750
150	230	Whse.	SK	1750
100	230	Whse.	SK	400/1200
100	230	Cr. Wh.	CMC	625
90	230	G. E.	CD	1750
80	230	G. E.	RC	600
50	230	Rel.	T	400/1200

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	440/220	Syn.	250
250	Whse.	2200	Syn.	250
175	G. E.	220/440	Syn.	230
125	G. E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	sq. ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G. E.	2200/440	Syn.	125
65	G. E.	2200/440	sq. ca.	250
65	G. E.	2200/440	sq. ca.	125
45	G. E.	440/220	sq. ca.	250

TRANSFORMERS 60 Cy.

3—667 kva, Al. Chal., 22000/11000/2300 V.
1—600 kva, Standard, 13,800-2300 V., 3 ph.
3—500 kva, G. E., 22000/11000—2300 V.
3—500 kva, Whse., 66000—2300 V.
3—333 kva, G. E., 12000—2300 V.
3—200 kva, G. E., 2300—575 V.
3—200 kva, G. E., 11000—2300 V.
3—200 kva, G. E., 4150—480/240 V.
3—150 kva, G. E., 33000—2300/4600 V.
3—150 kva, Al. Chal., 2400—240/480 V.
3—150 kva, Al. Chal., 2400—240/120 V.
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G. E., 4150—120/240 V.
2—100 kva, Whse., 2400—120/55 V.
3— 75 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V
3—50 kva, Whse., 440—220/110
6—50 kva, G.E., 2300—120/240

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1000 KVA PYRANOL BANK

3—333 KVA GE type H form K2DA —1 ph 60 cycle transformers 13800 volts primary, 460 volts secondary, ser. #6417472—3 & 4.

125 VOLT DC GENERATORS

KW	Make	Speed
200	West.	900
150	Westg.	1200
150	Westg. (3)	900
100	Cr. Wh.	1200
100	E.M.	1200
100	G. E. (2)	900
100	Westg.	1200
100	Westg. (2)	900
75	G. E. (2)	1200
50	Westg. (2)	1150

250 VOLT DC GENERATORS

KW	Make	Speed
2000	G. E.	NEW
1150	G. E.	NEW
750	G. E. (2)	NEW
400	G. E.	NEW
250	Cr. Wh.	1200
200	El. Mchy.	900
150	G. E.	1200
125	G. E. (2)	1200
125	E. D.	1750
100	Delco (4)	1150
75	Westg.	900
75	Cr. Wh.	1150

SYNCHRONOUS CONDENSER

1250 KVA Westg., 480 volts, 1200 RPM, with 15 KW direct connected Excitor. Late modern. Complete.

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(2) EX-LIBERTY SHIP BOILERS

24,000 pounds per hour—4890 sq. ft.—225 pounds working pressure. Made by Combustion Engineering Co. Located West Coast.

(3) SCOTCH MARINE BOILERS

225 pounds working pressure. Approximately 17,500 pounds each, per hour.

(4) 300 KW G.M. 8-268A DIESEL GEN.

G.M. diesel generator sets—120/240 volts DC —1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

NEW 60 KW CUMMINS DIESEL GEN. SET

60 KW—120 volts DC

(2) 100 KW GM 3-268A 440/60/3 AC generator sets.

(1) 100 KW LORIMER 440/60/3 AC generator set.

(1) 100 KW FAIRBANKS-MORSE opposed 440/60/3 AC generator set.

75 KW WAUKESHA DIESEL GEN.

Heavy duty—totally enclosed—with built-in switchgear. 75 KW—230 volts DC. 6 cyl. Waukesha diesel, 160 HP, 1200 RPM. Radiator cooled.

(6) 300 KW TURBO GENERATOR SETS

120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740°TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stabilized shunt generator. With switchgear. Built 1945. Excellent condition.

(1) SUPERIOR HEAVY DUTY DIESEL

510 HP at 360 RPM—5 cylinder—14½x8—type ZDSB—non-reversing—vertical—4 cycle—cold starting—mechanical injection. Engine totally enclosed. For heavy duty pumping, dredge service, power generation, textile & saw mills, etc. Excellent condition. Immediate delivery.

ELECTRIC WINCHES

50 HP—230 volts DC—built in controls—5 ton and 10 ton.

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25000 KVA AUTOTRANSFORMER

General Electric, Type HT, Form DD, 60 cycle, 3 phase serial 4126955, 0.812% impedance, 55° C. continuous, circular coil design, voltage rating—69300 Primary, 66000 Second. KVA rating as a two winding transformer—2500 KVA—with any voltage combination from 66 KV to 2.4 KV.

Some Possible Ratings as an Autotransformer on Standard Voltages

PRIMARY KV	SECONDARY KV	KV RATING
67	43.8	6500
67	34.4	4650
67	22.9	3450
34.4	22.9	6800
34.4	13.8	3750
34.4	13.2	3700
34.4	12.47	3550
34.4	12.0	3500
22.9	13.8	5700
22.9	13.2	5400
22.9	12.47	5000
22.9	12.0	4750
22.9	8.32	3550
22.9	7.2	3350
13.8	7.2	4750

We Will Rewind This Transformer To Your Specifications

BOILERS
1—350 HP Hedges-Walsh Weidner 225 psig

DIESEL GENERATORS
1—300 KVA Superior YLO—G.E. Gen 400 rpm 2200/440/3/60

TRANSFORMERS—1 PHASE 60 CYCLE
3—3333 KVA 66000 to 33000 & 13200 v.
1—1000 KVA 33000/11000/2300
2—1000 KVA 13800—2300 v.
3— 500 KVA 38100/66000 Y—2300 v.
3— 500 KVA 33000 v.—2300 v.
4— 500 KVA 13200 v.—2300 v.
4— 200 KVA 33000 v.—2300/4160 Y
5— 200 KVA 13200—2300/4160 Y
1— 200 KVA 12000—2300/4160 Y
3— 200 KVA 7620/13200 Y—2300
1— 150 KVA 6600—2300/4160 Y

TURBO GENERATORS
1000 KW West. Cond. 185 lbs 100 SH 3/60/2300
1500 KW G.E. Non-Cond. 140 lbs. 3/60/2300
1000 KW G.E. Non-Cond. 140 lbs. 3/60/2200

PUMPS—BOILER FEED
600 GPM 1220' hd. DeLaval 3550 RPM Requires 250 HP
600 GPM 1220' hd. Conn. 233 HP 3550 RPM 400 lb. pres. DeLaval turbine
400 GPM 1250' hd. Worth. 1750 RPM 5" x 4"

GENERATORS—GAS ENGINE
99¾ KVA 230/3/60 Star Buda with charger
66½ KVA 240/3/60 4 wire Waukesha-Bardco Type C12 truck mounted

SYNCHRONOUS MOTORS
400 HP 1800 RPM 2200 volts Westinghouse .8 PF
300 HP 400 RPM 2200/440/3/60 G.E.

CENTRIFUGAL PUMPS
5200 GPM 55' hd Worthington 18 x 14, 1150 RPM 100 hp required.
5000 GPM 214' hd Pennsylvania 15½ x 14, 1775 RPM 300 HP required.
4375 GPM 100' hd. DeLaval 14 x 12, 1270 RPM
3500 GPM 37' hd DeLaval 12 x 12, 1160 RPM 50 HP required.
3200 GPM 50' hd Gardner Denver 10 x 12, 1160 RPM 60 HP required.

AIR COMPRESSORS
570 CFM 17 x 12, 55 psi, single stage Ingersoll-Rand Type ERI, 85 hp
335 CFM 14 x 10, 100 psi single stage Ingersoll-Rand Type ERI, 100 hp.

TAMPA ARMATURE WORKS INC.

401 S.MORGAN ST. TAMPA, FLORIDA PHONE 2-1966

FOR SALE

250 H.P. Titusville Scotch Marine type boiler. 150 lb. pressure (about 5 yrs old) with Ray Oil Burner, stack and appurtenances. In perfect condition.

Make offer. Central Wisconsin location.

Write Rm. 305
77 East Washington, Chicago, Ill., or
call Central 6-3795, Chicago.

FOR SALE

2—Westinghouse AC Turbine generator units—non-condensing, 938 KVA, 3 phase, 60 cycle, 2300 V., 155 lbs.

1—Westinghouse AC Turbine generator unit—non-condensing, 1563 KVA, 3 phase, 60 cycle, 2300 V., 155 lbs.

Installed with auxiliaries and switchgear—not operating—can be started for inspection. Can be removed at once.

INDIANA UNIVERSITY
Purchasing Dept., Bloomington, Ind.

FOR SALE

MOTOR GENERATOR SETS

1—300 KW Ridgeway, 2200 Volts, AC, 275 Volts, DC, 1200 RPM, Manual Switchboard.
2—200 KW Allis-Chalmers, 2300 Volts, AC, 275 Volts, DC, 1200 RPM, complete with automatic reclosing circuit breaker and manual starter.
2—200 KW General Electric, 2300 Volts, AC, 275 volts, DC, 1200 RPM, complete with automatic reclosing circuit breakers and automatic starters.
1—200 KW Westinghouse, 2200 Volts, AC, 275 Volts, DC, 900 RPM with automatic circuit breaker and manual starter.
5—150 KW Westinghouse, 2200 Volts, AC, 275 Volts, DC, 1200 RPM complete with automatic reclosing circuit breaker and automatic starter.
1—150 KW General Electric, 2300 Volts, AC, 275 Volts, DC, 1200 RPM complete with automatic reclosing circuit breaker and automatic starter.
1—75 KW Westinghouse, 220 Volts, 250 Volts, DC, 580 RPM, with manual switchboard.
1—50 KW Allis-Chalmers, 2200 Volts, AC, 275 volts, DC, 900 RPM with manual switchboard.

ROTARY CONVERTERS

2—300 KW Allis-Chalmers 187 Volts, AC, 250 Volts, DC, 1200 RPM, complete with transformers and manual switchboard.
1—200 KW General Electric, 185 Volts, AC, 275 Volts, DC, 1200 RPM, complete with transformers and General Electric automatic switchboard.

We have a large stock of AC and DC totally enclosed ball bearing motors. Your inquiries are invited.

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CANTON, ILLINOIS
Phone 739 and 2438

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2—450 HP DeLavergne, 360 RPM, 5 Cyl. 15 x 18½, #1615-6, (1937) Falk Speed Increasers, 11 to 1 First Class Condition, $100.00 per Ton.

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Two Westinghouse "Type S" 50 KBA, 60 cycles, also, two General Electric 25 KBA 50/60 cycles, all single phase. Excellent condition.

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Specially Priced
DE LAVAL OIL PURIFIERS
"Uni-Matic" Model 65-13
Complete with suction and discharge pumps. Direct connected to 1½ h.p. G.E. motor.
Rebuilt and guaranteed.
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MOTORS · MG SETS

All guaranteed for one year.

Qty.	HP	Make	Voltage	Speed
12	3000	West.	525/600	600 RPM
28	1500	West.	525/600	600 RPM
32	1500	Al. Ch.	525/600	675 RPM
4	1200	Al. Ch.	525/600	650 RPM
2	900	Elliott	230	300/195 RPM
3	800	West.	525/600	600/900 RPM
1	650	Cr. Wh.	230	475/720 RPM
1	500	West.	230	250/500 RPM
1	400	G.E.	230	480/360 RPM
7	400	Elliott (new)	220	400/800 RPM
5	400	West. (new)	230	375/750 RPM
2	350	Cr. Wh.	230	400/800 RPM
1	200	Cr. Wh.	230	500/750 RPM
1	200	Cr. Wh.	230	375/750 RPM

All motors designed for mill reversing service.
Smaller sizes also in stock.
Motor Generator Sets In Stock
100—2000 KW Capacity

All of above is modern late type equipment remanufactured & tested by our engineers.
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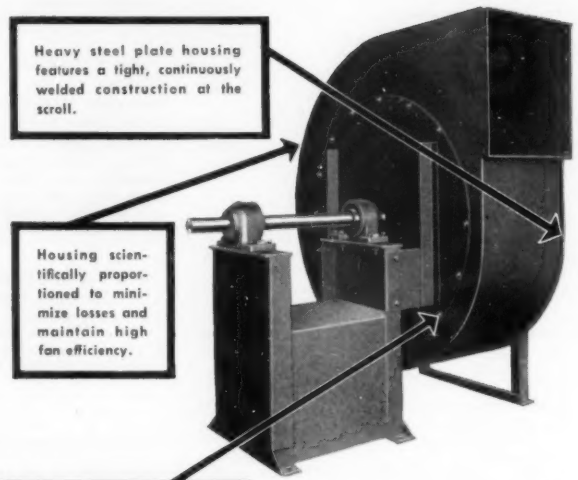
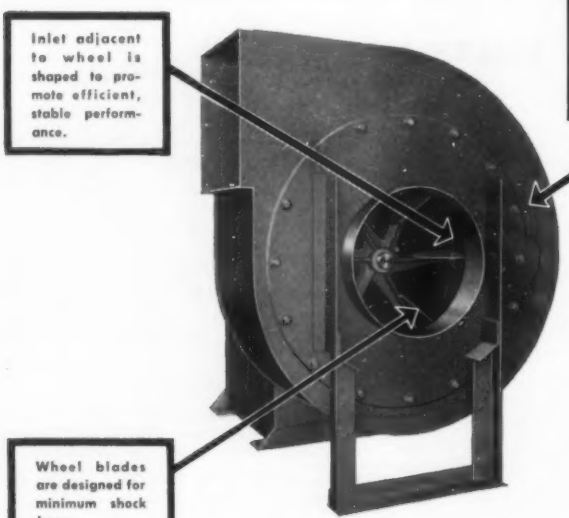
Announcing the new Clarage TYPE XL Industrial Fans

Exceptional Fan Equipment distinguished by:

1. High efficiency characteristic.
2. Rugged, tight construction.
3. Three interchangeable wheels — each with radial blades.
4. Large size range — 11″ through 60″ inlet diameters.
5. Pressures to 18″ SP; volumes to 130,000 CFM.


Heavy steel plate housing features a tight, continuously welded construction at the scroll.
Housing scientifically proportioned to minimize losses and maintain high fan efficiency.
Adjustable to any of eight standard discharges by merely removing tap bolts on each side and rotating the housing between the sideplates.


Inlet adjacent to wheel is shaped to promote efficient, stable performance.
Wheel blades are designed for minimum shock loss.

Type XL fans shown here are typical of the smaller sizes which provide universal discharge. Larger sizes are of reinforced sheet steel and base angle construction extending to the foundation line.

Send for Bulletin 702

A new, modern design offering many distinct advantages!

Clarage Type XL industrial fans are particularly well suited for diversified air and material handling applications. You'll profit from the high efficiency, in-the-field adaptability, and numerous other features of this exceptional fan equipment.

Learn more about these distinguishing features by requesting Bulletin 702, or contacting the nearest Clarage application engineering office.

CLARAGE FAN CO., Kalamazoo, Mich.

You can Rely on...

CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

*In addition to carbon steel and stainless steel**

GRINNELL
WELDING FITTINGS

may be had in

- **WROUGHT IRON**
- **ALUMINUM**
- **INCONEL**
- **PURE NICKEL & MONEL**
- **COPPER (Deoxidized)**
- **HASTELLOY ALLOYS, B & C**

Piping engineers can choose Grinnell Welding Fittings today from numerous materials having exceptional resistance to heat and cold, as well as the ability to cope successfully with troublesome fluids and gases.

Numbered among these are intermediate and high alloy steels containing chromium, nickel (or both)—plus other alloying elements such as molybdenum and copper. In addition, alloys are available which are composed primarily of nickel, copper or aluminum. Hastelloy Alloys B & C, developed primarily for severe chemical service, are also available.

Charted on this page are Grinnell Welding Fittings in a variety of materials and sizes.

**Covered in previous advertisements. Available on request.*

TYPE OF FITTING (All dimensions in inches)		WROUGHT IRON		ALUMINUM[1] Type 3S-F		INCONEL			NICKEL & MONEL			COPPER[2] Deoxidized		HASTELLOY ALLOYS B & C		
		Std. Wall	Ex. Str. Wall	Std. Wall	Ex. Str. Wall	Sch. 10	Std. Wall	Ex. Str. Wall	Sch. 10	Std. Wall	Ex. Str. Wall	Std. Wall	Ex. Str. Wall	Schedule 5	Schedule 10	Std. Wall
ELBOWS	90° Long Radius	½-12	½-12	½-16	½-16	½-12	½-12	½-12	½-12	½-12	½-12	½-24	½-24	½-8	½-8	½-8
	90° Short Radius	....	....	1-16	1½-16	....	....	....	....	....	....	....	....	....	....	....
	45° Long Radius	½-12	½-12	½-16	½-16	½-12	½-12	½-12	½-12	½-12	½-12	½-24	½-24	½-8	½-8	½-8
RETURNS	180° Long Radius	....	....	½-16	½-16	½-12	½-12	½-12	½-12	½-12	½-12	½-24	½-24	....	....	....
	180° Short Radius	....	....	1-16	1½-16	....	....	....	....	....	....	....	....	....	....	....
TEES	Straight Outlet	½-12	½-12	½-16	½-16	½-12	½-12	½-12	½-12	½-12	½-12	½-16	½-16	½ & larger	½ & larger	½ & larger
	Reducing Outlet	½-12	½-12	½-16	½-16	½-12	¾-12	¾-12	½-12	¾-12	¾-12	¾-16	¾-16	½ & larger	½ & larger	½ & larger
CROSSES	Straight Outlet	....	....	½-12	½-12	....	....	....	....	....	....	....	....	....	....	....
	Reducing Outlet	....	....	½-12	½-12	....	....	....	....	....	....	....	....	....	....	....
REDUCERS	Concentric	1-12	1-12	½-16	½-16	¾-12	¾-12	¾-12	¾-12	¾-12	¾-12	¾-12	¾-12	½ & larger	½ & larger	½ & larger
	Eccentric	1-12	1-12	½-16	½-16	¾-12	¾-12	¾-12	¾-12	¾-12	¾-12	¾-12	¾-12	½ & larger	½ & larger	½ & larger
STUB ENDS	ASA Length	½-12	½-12	½-24	½-24	½12-	½-12	½-12	½-12	½-12	½-12	½-12	½-24	½ & larger	½ & larger	½ & larger
	Short Length	....	....	....	....	½-12	½-12	½-12	½-12	½-12	½-12	....	....	½ & larger	½ & larger	½ & larger
CAPS		¾-12	¾-12	½ 24	½-24	½-12	½-12	½-12	½-12	½-12	½-12	½-24	½-24	½ & larger	½ & larger	½ & larger

1. Type 2S-F Alclad, 3S-F, and Type 61S-T6 also available.

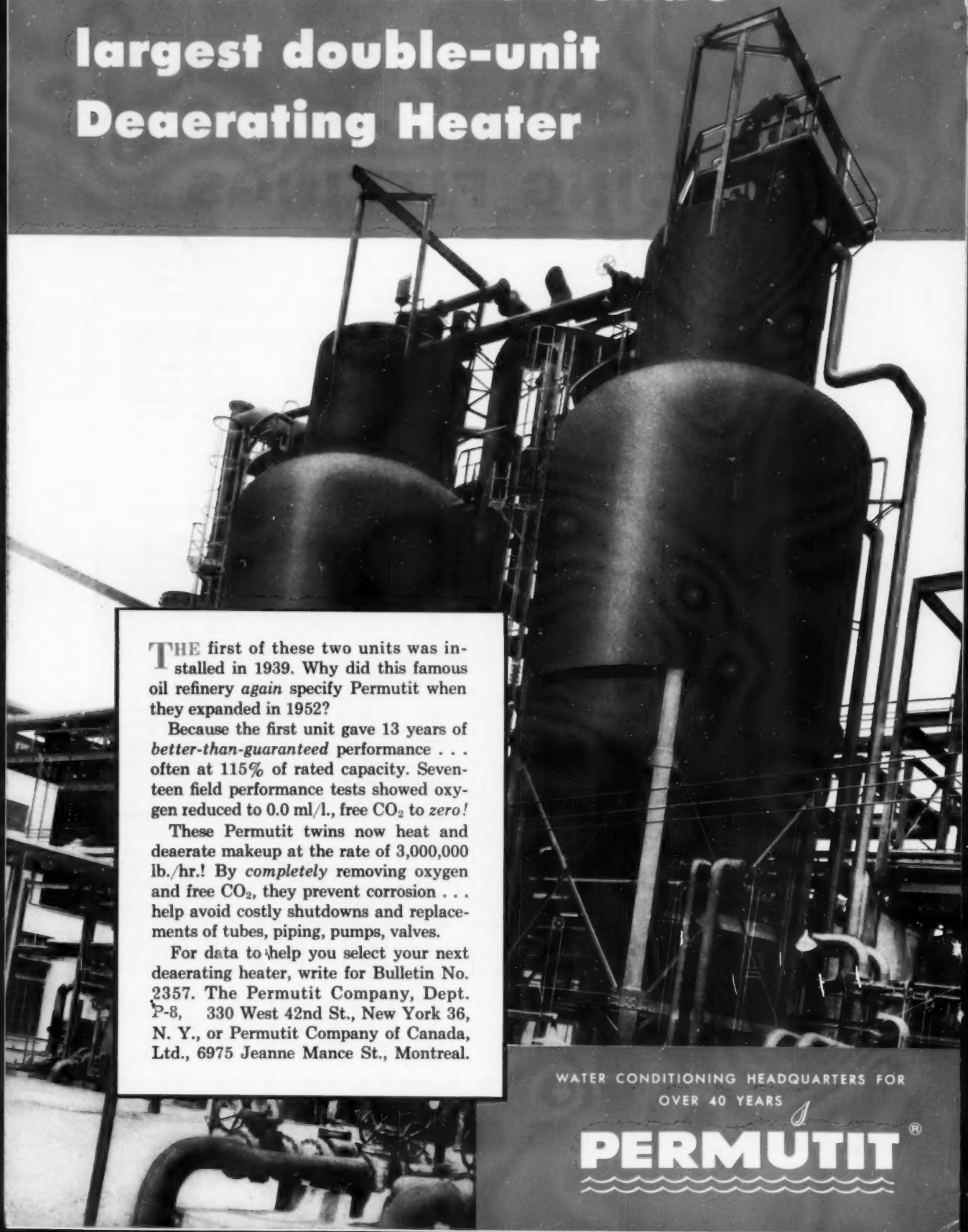
2. Red brass, low silicon bronze, admiralty metal, aluminum bronze and other copper alloys available on request.

GRINNELL
WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Permutit installs world's largest double-unit Deaerating Heater



THE first of these two units was installed in 1939. Why did this famous oil refinery *again* specify Permutit when they expanded in 1952?

Because the first unit gave 13 years of *better-than-guaranteed* performance . . . often at 115% of rated capacity. Seventeen field performance tests showed oxygen reduced to 0.0 ml/l., free CO_2 to *zero!*

These Permutit twins now heat and deaerate makeup at the rate of 3,000,000 lb./hr.! By *completely* removing oxygen and free CO_2, they prevent corrosion . . . help avoid costly shutdowns and replacements of tubes, piping, pumps, valves.

For data to help you select your next deaerating heater, write for Bulletin No. 2357. The Permutit Company, Dept. P-8, 330 West 42nd St., New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS

PERMUTIT®